U.S. ENVIRONMENTAL PROTECTION AGENCY
INFORMATION COLLECTION REQUEST
EMISSION SUMMARY REPORT
COKE OVENS ICR
AK STEEL, INC.
MIDDLETOWN, OHIO

Prepared for:

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1. INTRODUCTION

Environmental Quality Management, Inc. (EQM) was retained by AK Steel, Inc. to conduct an emission measurement program at the Middletown Works facility in Middletown, Ohio, in response to the USEPA information collection request (ICR) dated April 4, 2016. This program served to determine the concentration and mass emission rate of total particulate matter, $PM_{2.5}$, toluene-soluble organics (TSO), hydrogen sulfide (H_2S), sulfur dioxide (SO_2), carbon monoxide (CO), speciated volatile organic HAP (VOHAP), hydrogen cyanide (HCN), hydrogen fluoride (HF), hydrogen chloride (HCl), metals (Mn, As, Pb, Cd, Ni, Cr, Sb, Be, Co, Hg, Se), and semi-volatile organic HAP (including polycyclic aromatic hydrocarbons (PAHs) and dioxin/furans), from Emission Process (EP) Units 1 (Pushing Operations Baghouse) and 3 (Combustion Stack). Sampling was conducted following the procedures of EPA Methods 1, 2, 3A, 4, 5, 6C, 9, 10, 15, 26A, 29, 201A, 202, 303, 315, 316, OTM 29, SW 846 0031, California Air Resources Board (CARB) Method 428, and CARB Method 429. At EP-1, baghouse dust samples were also collected and analyzed for mercury (EPA SW846 Method 7471B) and PAH/POM (EPA SW 846 Method 8100).

At EP-9 (Quench Tower), water sampling was conducted to measure the following pollutants: pH, total dissolved solids (TDS) (EPA Method 160.1), HAP metals (EPA Method 200.7), HCl (Standard Method 4500-Cl^-), HCN (Standard Method 4500-CN^-), HF (Standard Method 4500-F^-), total sulfide (Standard Method 4500-$S2^-$ Sulfide), Semi-volatiles (EPA Method 610 and 1613B), total sulfate (SW 846 Method 905A), and VOHAP (EPA Method 602 & 624, SW846 8260B).

At EP-5 (Flare Inlet), the heat content of the coke oven gas at the flare inlet was analyzed. Coke oven feed (coal) and coke oven gas samples were taken and analyzed for mercury (EPA SW846 Method 7471B and ASTM D5954-98, respectively).

An outline of the sampling methods and parameters is presented in Table 1-1. The emission testing program was conducted from August 23, 2016 until September 16, 2016.

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Table 1-1. Sampling Locations and Test Parameters

Stack I.D.	Test Method	Parameter	Sample Volume, m^3	Approximate Run Time/Sample, minutes
EP-1: Pushing Baghouse	1-2	Flow	--	--
	3A	O_2/CO_2	--	--
	4	% H_2O	--	180
	5	PM	3	180
	6C	SO_2	--	60
	9	Opacity	--	--
	10	CO	--	--
	15	H_2S	--	60
	26A	HCl/HF	1	60
	29	Metals	3	180
	202	Condensable PM	2	120
	315	TSO	2	120
	316	Formaldehyde	1	60
	OTM 29	HCN	1	60
	SW846 0031	VOHAP	--	60
	CARB 428	Dioxin/Furan	4	240
	CARB 429	PAH	4	240
EP-3: Combustion Stack	1-2	Flow	--	--
	3A	O_2/CO_2	--	--
	4	% H_2O	--	180
	5	PM	3	180
	6C	SO_2	--	60
	203	Opacity via COMS	--	--
	10	CO	--	--
	15	H_2S	--	60
	26A	HCl/HF	1	60
	29	Metals	3	180
	201A	PM_{10}	2	120
	202	Condensable PM	2	120
	315	TSO	2	120
	316	Formaldehyde	1	60
	OTM 29	HCN	1	60
	SW846 0031	VOHAP	--	60
	CARB 428	Dioxin/Furan	4	240
	CARB 429	PAH	4	240
EP-10: Quench Tower	EPA Method 200.7	Metals	--	--
	Standard Methods 4500-$S2^-$ Sulfide	Total Sulfide	--	--
	SW846 Method 9056A	Total Sulfates	--	--
	EPA Method 602&624, SW846 8260B	VOHAP	--	--
	Standard Methods 4500-Cl^-, -F^-, CN	HCl, HF, HCN	--	--
	EPA Method 610	PAH	--	--

Stack I.D.	Test Method	Parameter	Sample Volume, m^3	Approximate Run Time/Sample, minutes
	EPA Method 1613B	Dioxin/Furan	--	--
	EPA Method 160.1	TDS	--	--
	pH	--	--	--
EP-5: Flare Inlet (Coke Oven Gas)	ASTM D3588	Heat Content	--	--
	ASTM D5954-98	Hg		
Coal	SW846, Method 7471A	Hg		
Baghouse Dust	SW486 Method 7471A	Hg		
	SW846 Method 8270C	PAH/POM		

2. SUMMARY OF TEST RESULTS

2.1 EP-1 Pushing Baghouse

The EP-1 Pushing Baghouse was sampled to determine the emission profile for the following pollutants: filterable particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), hydrogen sulfide (H_2S), hydrogen chloride/hydrogen fluoride (HCL/HF), metals, condensable PM, toluene soluble organics (TSO), formaldehyde, hydrogen cyanide (HCN), volatile oganic hazardous air pollutants (VOHAP), polycyclic aromatic hydrocarbons (PAH), dioxin/furans (D/F), and opacity.

The Pushing Baghouse has a total of five fans, each with a dedicated exhaust, although not all five fans run during normal operation. Three fans/exhausts were sampled, while the other two fans/exhausts were electrically and mechanically isolated. Flow and PM were measured at each of the three stacks in service during the sampling. A diagram of the stack and sampling configuration is provided in Appendix B.

Some of the emission results are less than the laboratory's reported detection level and are indicated as below detection level (BDL). If at least one but not all values used to calculate the emission rate average, including a single fraction of a multiple fraction sample (metals), are less than the laboratory's reported value, then the data is reported as detection level limited (DLL). This nomenclature was indicated in the ICR for data reporting. Data was corrected for detected blank amounts by subtracting the reagent blank result from the analyte total. If the analyte was not detected in the blank, then the result was not blank corrected. If the blank value was greater than the run result, a "0" was entered for that fraction.

2.1.1 Stack Gas Conditions and Pollutant Emissions

2.1.1.1 Stack Gas Conditions

Table P-1 details the results of the pushing baghouse exhausts measured concurrently with the emission test runs conducted on the three exhaust stacks.

Table P-1. Stack Gas Conditions at Pushing Baghouse

Date	Stack Observed	Other Test Methods Performed	Stack Gas Velocity fps[a]	Volumetric Flow Rate		Stack Temperature, °F	Moisture Content, % H_2O	CO_2, %	O_2, %
				acfm[b]	dscfm[c]				
08/23/2016	1	Method 6 and 15	109.3	45,079	40,130	123	1.5	0.3	20.7
08/23/2016	2	OTM 29	106.5	43,905	39,331	118	1.6	0.3	20.7
08/23/2016	3	Method 26	104.2	42,978	38,730	115	1.5	0.3	20.7
			106.67	131,962	118,191	118.67	1.53	0.3	20.7
08/24/2016	1	Method 6 and 15	109.9	45,311	40,782	117	1.5	0.2	20.8
08/24/2016	2	OTM 29	101.8	41,981	38,379	106	1.9	0.2	20.8
08/24/2016	3	Method 26	104.4	43,039	38,874	110	2.2	0.2	20.8
			105.37	130,331	118,035	111.	1.87	0.2	20.8
08/25/2016	1	Method 6 and 15	96.9	39,946	35,941	124	1.5	0.3	20.7
08/25/2016	2	OTM 29	103	42,465	37,807	121	3	0.3	20.7
08/25/2016	3	Method 26	103.6	42,725	38,123	118	3.1	0.3	20.7
			101.17	125,136	111,871	121.	2.53	0.3	20.7
08/29/2016	1	NA	102.7	42,356	37,932	123	1.5	0.2	20.7
08/29/2016	2	Method 5/202	99.3	40,963	36,400	123	2.3	0.2	20.7
08/29/2016	3	Method 5/29	103.9	42,851	38,127	120	2.4	0.2	20.7
			101.97	126,170	112,459	122.	2.07	0.2	20.7
08/30/2016	1	VOHAP	112.2	46,287	41,827	117	2	0.2	20.7
08/30/2016	2	Method 5/202	99.3	40,963	36,400	123	2.3	0.2	20.7
08/30/2016	3	Method 5/29	103.9	42,851	38,127	120	2.4	0.2	20.7
			105.13	130,101	116,354	120.	2.23	0.2	20.7
08/31/2016	1	VOHAP	113.9	46,952	42,265	114	2.3	0.2	20.5
08/31/2016	2	Method 5/202	100.9	41,590	36,971	121	2.4	0.2	20.5
08/31/2016	3	Method 5/29	104.7	43,177	39,025	111	2.2	0.2	20.5
			106.5	131,719	118,261	115.33	2.3	0.2	20.5
09/01/2016	1	VOHAP	115	47,435	43,471	109	1.5	0.1	20.8
09/01/2016	2	Method 5/202	100.8	41,586	36,967	121	2.4	0.1	20.8
09/01/2016	3	Method 5/29	104.7	43,172	39,020	111	2.2	0.1	20.8
			106.83	132,193	119,458	113.67	2.03	0.1	20.8
09/06/2016	1	NA	109.9	45,303	40,851	119	1.6	0.2	20.8
09/06/2016	2	Method 5/202	104.4	43,055	37,601	134	2.4	0.2	20.8
09/06/2016	3	Method 5/29	104.8	43,207	38,257	124	2.5	0.2	20.8
			106.37	131,565	116,709	125.67	2.17	0.2	20.8
09/07/2016	1	NA	109.9	45,310	40,857	119	1.6	0.2	20.6
09/07/2016	2	Method 5/202	104.4	43,061	37,607	134	2.4	0.2	20.6
09/07/2016	3	Method 5/29	104.8	43,214	38,262	124	2.5	0.2	20.6
			106.37	131,585	116,726	125.67	2.17	0.2	20.6

Table P-1. Stack Gas Conditions at Pushing Baghouse

Date	Stack Observed	Other Test Methods Performed	Stack Gas Velocity fps[a]	Volumetric Flow Rate		Stack Temperature, °F	Moisture Content, % H_2O	CO_2, %	O_2, %
				acfm[b]	dscfm[c]				
09/12/2016	1	NA	104.7	43,162	38,760	123	1.5	0.2	20.7
09/12/2016	2	Method 315	106.9	44,082	40,207	114	1.5	0.2	20.7
09/12/2016	3	CARB 428/429	102.9	42,453	39,142	106	1.6	0.2	20.7
			104.83	129,697	118,109	114.33	1.53	0.2	20.7
09/13/2016	1	NA	113.3	46,713	41,292	131	1.5	0.2	20.6
09/13/2016	2	Method 315	106.6	43,956	39,491	120	1.8	0.2	20.6
09/13/2016	3	CARB 428/429	102.9	42,455	39,144	106	1.6	0.2	20.6
			107.6	133,124	119,927	119.	1.63	0.2	20.6
09/14/2016	1	NA	113.2	46,692	42,955	109	1.5	0.2	20.6
09/14/2016	2	NA	103.7	42,756	38,550	121	1.5	0.2	20.6
09/14/2016	3	CARB 428/429	101.2	41,731	38,101	108	2.1	0.2	20.6
			106.03	131,179	119,606	112.67	1.7	0.2	20.6
09/15/2016	1	NA	114.4	47,163	42978	115	1.5	0.3	20.6
09/15/2016	2	Method 315	105.7	43,602	40,303	106	1.6	0.3	20.6
09/15/2016	3	CARB 428/429	100.7	41,535	38,287	103	2.2	0.3	20.6
			106.93	132,300	121,568	108.	1.77	0.3	20.6

[a]Feet per second.
[b]Actual cubic feet per minute.
[c]Dry standard cubic feet per minute.

2.1.1.2 PM/Metals (Sb, As, Be, Cd, Cr, Co, Pb, Mn, Hg, Ni, Se)

Table P-2 details the pushing baghouse exhaust conditions measured under each PM/Metals test run. Continuous samples for stack gas composition were collected during each pollutant run and analyzed via Method 3A for O_2 and CO_2 composition. The PM and metals results are reported in the units specified in the ICR: µg/dscm and lb/hr.

Table P-2. Summary of Pushing Baghouse: PM and Metals

August 29 - September 7, 2016 AK Steel, Middletown, Ohio

	Detection Limit, µg	Run No.			Average
		P-29-1	P-29-2	P-29-3	
Start Date/Time		08/29/16, 10:24	08/31/16, 10:20	09/06/16, 10:26	
End Date/Time		08/30/16, 17:38	09/01/16, 16:20	09/07/16, 17:57	
Filt. PM		ADL	ADL	ADL	ADL
mg/dscm	400	0.8	1.3	0.9	1.0
lb/hr		0.11	0.19	0.13	0.14
Antimony		DLL	BDL	BDL	DLL
µg/dscm	0.2	2.23E-01	4.63E-03	4.90E-03	7.74E-02
lb/hr		3.17E-05	6.76E-07	7.01E-07	1.10E-05
Arsenic		BDL	BDL	BDL	BDL
µg/dscm	1.0	2.84E-01	3.09E-01	3.27E-01	3.06E-01
lb/hr		4.04E-05	4.50E-05	4.67E-05	4.40E-05
Beryllium		BDL	BDL	BDL	BDL
µg/dscm	0.2	5.67E-02	6.18E-02	6.54E-02	6.13E-02
lb/hr		8.08E-06	9.01E-06	9.34E-06	8.81E-06
Cadmium		BDL	BDL	BDL	BDL
µg/dscm	0.1	2.84E-02	3.09E-02	3.27E-02	3.06E-02
lb/hr		4.04E-06	4.50E-06	4.67E-06	4.40E-06
Chromium		ADL	ADL	ADL	ADL
µg/dscm	1.0	5.90E+00	4.86E+00	3.29E+00	4.68E+00
lb/hr		8.41E-04	7.09E-04	4.70E-04	6.73E-04
Cobalt		DLL	DLL	DLL	DLL
µg/dscm	0.2	8.71E-02	6.18E-02	6.54E-02	7.14E-02
lb/hr		1.24E-05	9.01E-06	9.34E-06	1.02E-05
Lead		ADL	ADL	ADL	ADL
µg/dscm	0.5	3.26E-01	3.27E-01	3.33E-01	3.29E-01
lb/hr		4.64E-05	4.77E-05	4.76E-05	4.73E-05
Manganese		ADL	ADL	ADL	ADL
µg/dscm	0.5	3.08E+00	2.01E+00	2.31E+00	2.47E+00
lb/hr		4.39E-04	2.93E-04	3.30E-04	3.54E-04
Mercury		BDL	BDL	BDL	BDL
µg/dscm	0.12	3.40E-02	3.71E-02	3.92E-02	3.68E-02
lb/hr		4.85E-06	5.40E-06	5.61E-06	5.29E-06
Nickel		ADL	ADL	ADL	ADL
µg/dscm	0.2	5.37E+00	3.44E+00	2.26E+00	3.69E+00
lb/hr		7.65E-04	5.02E-04	3.22E-04	5.30E-04
Selenium		BDL	BDL	BDL	BDL
µg/dscm	2.0	5.67E-01	6.18E-01	6.54E-01	6.13E-01
lb/hr		8.08E-05	9.01E-05	9.34E-05	8.81E-05

Testing runs that occurred over multiple days included 4-hour stops (18:00-22:00 and 06:00-10:00) due to pushing schedule.
Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.1.1.3 Total PM

Table P-3 details the pushing baghouse exhaust conditions measured under each filterable and condensable PM test run. Results are reported in the units specified in the ICR: mg/dscm and lb/hr.

Table P-3. Summary of Pushing Baghouse: Total Particulate

August 29 - September 7, 2016 AK Steel, Middletown, Ohio

Start Time/Date	Detection Limit, Mg	Run No. P-202-1	P-202-2	P-202-3	Average
		10:24, 08/29/2016	10:20, 08/31/2016	10:26, 09/06/2016	
End Time/Date		13:51, 08/30/2016	13:49, 09/01/2016	16:19, 09/07/2016	
Filt. PM		ADL	DLL	ADL	DLL
mg/dscm	0.4	0.90	0.80	1.39	1.03
lb/hr		0.12	0.11	0.20	0.14
Condensable PM		ADL	ADL	ADL	ADL
mg/dscm	0.4	2.01	2.08	4.15	2.75
lb/hr		0.27	0.29	0.58	0.38
Total PM		ADL	DLL	ADL	DLL
mg/dscm	0.4	2.91	2.89	5.54	3.78
lb/hr		0.40	0.40	0.78	0.53

Testing runs that occurred over multiple days included 4-hour stops (18:00-22:00 and 06:00-10:00) due to pushing schedule.
Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.1.1.4 HCl/HF

Table P-4 details the pushing baghouse exhaust conditions measured under each HCl/HF and HCN test run. The HCl/HF/HCN results are reported in the units specified in the ICR: mg/dscm and lb/hr.

Table P-4. Summary of Pushing Baghouse: Hydrogen Chloride, Hydrogen Fluoride, and Hydrogen Cyanide

August 23-25, 2016 AK Steel, Middletown, Ohio

	Detection Limit, mg	Run No. P-26-2	Run No. P-26-3	Run No. P-26-4	Average
Date		08/23/2016	08/24/2016	08/25/2016	
Start/End Time		13:52-17:26	10:27-15:26	10:28-15:09	
Hydrogen Chloride (HCl)	0.071	ADL	ADL	ADL	ADL
mg/dscm		3.79E-01	2.75E-01	3.22E-01	3.25E-01
lb/hr		5.26E-02	3.99E-02	4.58E-02	4.61E-02
Hydrogen Fluoride (HF)	0.1	BDL	BDL	BDL	BDL
mg/dscm		1.02E-01	9.62E-02	9.84E-02	9.90E-02
lb/hr		1.42E-02	1.40E-02	1.40E-02	1.41E-02
Hydrogen Cyanide (HCN)	0.1	ADL	ADL	ADL	ADL
mg/dscm		1.80E-01	1.19E-01	1.60E-01	1.53E-01
lb/hr		2.64E-02	1.71E-02	2.26E-02	2.20E-02

Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.
Note: Run 1 is not included due to a low isokinetic rate. Results are included in the Appendix.

2.1.1.5 Sulfur Dioxide, Carbon Monoxide and Hydrogen Sulfide

Table P-5 details the pushing baghouse exhaust conditions measured under each SO_2, CO, and H_2S test run. Emission results are summarized and reported in the units specified in the ICR: ppm and lb/hr.

Table P-5. Summary of Pushing Baghouse
Hydrogen Sulfide, Sulfur Dioxide, and Carbon Monoxide

August 23-25, 2016 AK Steel, Middletown, Ohio

	Detection Limit, ppb	Run No.			Average
		P-15-1	P-15-2	P-15-3	
Date		08/23/2016	08/24/2016	08/25/2016	
Start/End Time		10:22-15:09	10:27-15:09	10:28-15:10	
Hydrogen Sulfide (H_2S)	50	BDL	ADL	BDL	DLL
ppm		5.00E-03	1.20E-02	5.00E-03	7.33E-03
lb/hr		1.07E-03	2.59E-03	9.52E-04	1.54E-03
Sulfur Dioxide (SO_2)	1000	ADL	ADL	ADL	ADL
ppm		4.61	3.01	5.51	4.37
lb/hr		1.85	1.22	1.97	1.68
Carbon Monoxide (CO)	1000	ADL	ADL	ADL	ADL
ppm		31.6	21.6	24.0	25.7
lb/hr		5.54	3.84	3.75	4.38

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.1.1.6 Toluene Soluble Organics

Table P-6 details the pushing baghouse exhaust conditions measured under each TSO test run. Emission results are presented as mg/dscfm and lb/hr.

Table P-6. Summary of Pushing Baghouse
Toluene Soluble Organic Particulate Matter

September 12-15, 2016 AK Steel, Middletown, Ohio

	Detection Limit, mg	Run No.			Average
		P-315-1	P-315-2	P-315-3	
StartTime/Date		10:26, 09/12/2016	13:39, 09/13/2016	16:35, 09/14/2016	
EndTime/Date		00:07 09/13/2016	03:27 09/14/2016	10:49 09/15/2016	
PM	0.4	DLL	DLL	DLL	DLL
mg/dscm		0.52	0.31	0.52	0.45
lb/hr		0.08	0.05	0.08	0.07
MCEM	0.4	DLL	DLL	DLL	DLL
mg/dscm		5.59	15.21	4.92	8.58
lb/hr		0.84	2.25	0.74	1.28

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.

2.1.1.7 Volatile Organic Hazardous Air Pollutants

Table P-7 details the furnace exhaust conditions measured under each SW846 0031 sampling run for VOHAP. Results are summarized for each compound as a concentration (mg/dscm) and mass emission rate (lb/hr) as specified in the ICR.

Table P-7. Summary of Pushing Baghouse: Speciated Volatile Organic HAPs (VOHAP)

August 30 - September 1, 2016 AK Steel, Middletown, Ohio

	Detection Limit, µg	Run No. P-0031-1	P-0031-2	P-0031-3	Average
Date		08/30/2016	08/31/2016	09/01/2016	
Time		10:26-16:02	10:20-16:03	10:20-16:04	
Chloromethane		BDL	DLL	BDL	DLL
mg/dscm	0.06	2.14E-02	2.45E-02	2.22E-02	2.27E-02
lb/hr		3.10E-03	3.62E-03	3.39E-03	3.37E-03
Vinyl Chloride		BDL	BDL	BDL	BDL
mg/dscm	0.02	7.13E-03	7.14E-03	7.39E-03	7.22E-03
lb/hr		1.03E-03	1.06E-03	1.13E-03	1.07E-03
Bromomethane		BDL	BDL	BDL	BDL
mg/dscm	0.09	3.21E-02	3.21E-02	3.33E-02	3.25E-02
lb/hr		4.65E-03	4.76E-03	5.09E-03	4.83E-03
Chloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.02	7.13E-03	7.14E-03	7.39E-03	7.22E-03
lb/hr		1.03E-03	1.06E-03	1.13E-03	1.07E-03
1,1-Dichloroethene		BDL	BDL	BDL	BDL
mg/dscm	0.01	3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
Iodomethane		BDL	BDL	BDL	BDL
mg/dscm	0.03	1.07E-02	1.07E-02	1.11E-02	1.08E-02
lb/hr		1.55E-03	1.59E-03	1.70E-03	1.61E-03
Carbon Disulfide		BDL	DLL	DLL	DLL
mg/dscm	0.02	7.13E-03	9.31E-03	7.77E-03	8.07E-03
lb/hr		1.03E-03	1.38E-03	1.19E-03	1.20E-03
Methylene Chloride		DLL	DLL	DLL	DLL
mg/dscm	0.1	4.22E-02	4.46E-02	3.90E-02	4.19E-02
lb/hr		6.11E-03	6.60E-03	5.97E-03	6.18E-03
Chloroform		BDL	BDL	BDL	BDL
mg/dscm	0.01	3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
1,1,1-Trichloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.01	3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04

	Detection Limit, µg	Run No.			Average
		P-0031-1	P-0031-2	P-0031-3	
Date		08/30/2016	08/31/2016	09/01/2016	
Time		10:26-16:02	10:20-16:03	10:20-16:04	
Carbon Tetrachloride	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
Benzene	0.5	ADL	ADL	DLL	DLL
mg/dscm		2.16E-01	1.72E-01	4.76E-02	1.45E-01
lb/hr		3.12E-02	2.55E-02	7.28E-03	2.13E-02
1,2-Dichloroethane	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
Trichloroethene	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
1,2-Dichloropropane	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
Toluene	0.05	DLL	DLL	DLL	DLL
mg/dscm		6.61E-02	4.85E-02	3.14E-02	4.87E-02
lb/hr		9.59E-03	7.17E-03	4.80E-03	7.18E-03
1,1,2-Trichloroethane	0.02	BDL	BDL	BDL	BDL
mg/dscm		7.13E-03	7.14E-03	7.39E-03	7.22E-03
lb/hr		1.03E-03	1.06E-03	1.13E-03	1.07E-03
Tetrachloroethene	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
Chlorobenzene	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04
Ethylbenzene	0.01	DLL	DLL	BDL	DLL
mg/dscm		4.61E-03	4.89E-03	3.70E-03	4.40E-03
lb/hr		6.69E-04	7.24E-04	5.65E-04	6.53E-04
M&P Xylene	0.03	DLL	DLL	BDL	DLL
mg/dscm		1.89E-02	1.83E-02	1.11E-02	1.61E-02
lb/hr		2.73E-03	2.71E-03	1.70E-03	2.38E-03
O-Xylene	0.01	DLL	DLL	BDL	DLL
mg/dscm		4.94E-03	4.91E-03	3.70E-03	4.51E-03
lb/hr		7.16E-04	7.26E-04	5.65E-04	6.69E-04
Styrene	0.02	DLL	DLL	BDL	DLL
mg/dscm		7.37E-02	7.52E-02	7.39E-03	5.21E-02
lb/hr		1.07E-02	1.11E-02	1.13E-03	7.65E-03
Bromoform	0.01	BDL	BDL	BDL	BDL
mg/dscm		3.57E-03	3.57E-03	3.70E-03	3.61E-03
lb/hr		5.17E-04	5.28E-04	5.65E-04	5.37E-04

	Detection Limit, µg	Run No.			Average
		P-0031-1	P-0031-2	P-0031-3	
Date		08/30/2016	08/31/2016	09/01/2016	
Time		10:26-16:02	10:20-16:03	10:20-16:04	
1,1,2,2-Tetrachloroethane	0.02	BDL	BDL	BDL	BDL
mg/dscm		7.13E-03	7.14E-03	7.39E-03	7.22E-03
lb/hr		1.03E-03	1.06E-03	1.13E-03	1.07E-03
Acrylonitrile	0.05	BDL	BDL	BDL	BDL
mg/dscm		1.78E-02	1.79E-02	1.85E-02	1.81E-02
lb/hr		2.58E-03	2.64E-03	2.83E-03	2.68E-03
Formaldehyde	2.5	BDL	BDL	BDL	BDL
mg/dscm		2.13E-06	2.15E-06	1.95E-06	2.08E-06
lb/hr		3.33E-07	3.39E-07	3.17E-07	8.81E-07

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.1.1.8 PCBs, D/F and PAHs

Table P-8 details the furnace exhaust conditions measured under each California Air Resources Board (CARB) Method 428 sampling run for PCBs, D/F and PAHs. Results are summarized for each compound as a concentration (µg/dscm) and mass emission rate (lb/hr) as specified in the ICR.

Table P-8. Summary of Pushing Baghouse: Semi-Volatile Organic HAPs (VOHAP)

September 12-15, 2016 AK Steel, Middletown, Ohio

	Detection Limit, pg	Run No.			Average
		P-CARB-1	P-CARB-2	P-CARB-3	
Start Time/Date		10:26, 09/12/2016	13:39, 09/13/2016	16:35, 09/14/2016	
End Time/Date		12:20, 09/13/2016	16:17, 09/14/2016	23:40, 09/15/2016	
2,3,7,8-TCDD	0.99	BDL	BDL	BDL	BDL
µg/dscm		2.43E-07	2.71E-07	3.84E-07	2.99E-07
lb/hr		3.55E-11	3.86E-11	5.49E-11	4.30E-11
1,2,3,7,8-PeCDD	0.72	BDL	BDL	BDL	BDL
µg/dscm		1.51E-07	2.10E-07	1.85E-07	1.82E-07
lb/hr		2.20E-11	2.98E-11	2.64E-11	2.61E-11
1,2,3,4,7,8-HxCDD	0.97	BDL	BDL	BDL	BDL
µg/dscm		2.91E-07	2.39E-07	2.64E-07	2.65E-07
lb/hr		4.26E-11	3.41E-11	3.78E-11	3.81E-11
1,2,3,6,7,8-HxCDD	0.87	BDL	BDL	BDL	BDL
µg/dscm		2.67E-07	2.14E-07	2.35E-07	2.39E-07
lb/hr		3.90E-11	3.05E-11	3.36E-11	3.44E-11

	Detection Limit, pg	Run No.			Average
		P-CARB-1	P-CARB-2	P-CARB-3	
Start Time/Date		10:26, 09/12/2016	13:39, 09/13/2016	16:35, 09/14/2016	
End Time/Date		12:20, 09/13/2016	16:17, 09/14/2016	23:40, 09/15/2016	
1,2,3,7,8,9-HxCDD		BDL	BDL	BDL	BDL
µg/dscm	0.96	2.91E-07	2.37E-07	2.64E-07	2.64E-07
lb/hr		4.26E-11	3.37E-11	3.78E-11	3.80E-11
1,2,3,4,6,7,8-HpCDD		ADL	ADL	BDL	DLL
µg/dscm	0.99	3.86E-07	9.42E-07	2.35E-07	5.21E-07
lb/hr		5.64E-11	1.34E-10	3.36E-11	7.47E-11
OCDD		ADL	ADL	BDL	DLL
µg/dscm	3.77	1.44E-06	5.33E-06	6.69E-07	2.49E-06
lb/hr		2.11E-10	7.58E-10	9.96E-11	3.56E-10
Total Dioxins		DLL	DLL	BDL	DLL
µg/dscm	NA	3.07E-06	7.44E-06	2.26E-06	4.26E-06
lb/hr		4.49E-10	1.06E-09	3.24E-10	6.11E-10
2,3,7,8-TCDF		ADL	ADL	ADL	ADL
µg/dscm	0.59	9.69E-07	3.25E-07	5.81E-07	6.25E-07
lb/hr		1.42E-10	4.63E-11	8.31E-11	9.04E-11
1,2,3,7,8-PeCDF		ADL	BDL	BDL	DLL
µg/dscm	1.2	4.76E-07	5.42E-07	1.49E-07	3.89E-07
lb/hr		6.96E-11	7.72E-11	2.13E-11	5.60E-11
2,3,4,7,8-PeCDF		ADL	BDL	BDL	DLL
µg/dscm	0.35	2.91E-07	3.94E-07	1.46E-07	2.77E-07
lb/hr		4.26E-11	5.62E-11	2.09E-11	3.99E-11
1,2,3,4,7,8-HxCDF		BDL	ADL	BDL	DLL
µg/dscm	0.52	1.29E-07	2.19E-07	1.80E-07	1.76E-07
lb/hr		1.88E-11	3.12E-11	2.58E-11	2.53E-11
1,2,3,6,7,8-HxCDF		BDL	ADL	BDL	DLL
µg/dscm	0.47	1.14E-07	2.37E-07	1.61E-07	1.71E-07
lb/hr		1.67E-11	3.37E-11	2.30E-11	2.45E-11
2,3,4,6,7,8-HxCDF		BDL	BDL	BDL	BDL
µg/dscm	0.51	1.24E-07	1.21E-07	1.75E-07	1.40E-07
lb/hr		1.81E-11	1.72E-11	2.51E-11	2.01E-11
1,2,3,7,8,9-HxCDF		BDL	BDL	BDL	BDL
µg/dscm	1.3	5.34E-07	3.70E-07	2.11E-07	3.72E-07
lb/hr		7.81E-11	5.27E-11	3.02E-11	5.37E-11
1,2,3,4,6,7,8-HpCDF		BDL	BDL	BDL	BDL
µg/dscm	0.58	2.33E-07	3.94E-07	2.40E-07	2.89E-07
lb/hr		3.41E-11	5.62E-11	3.43E-11	4.15E-11
1,2,3,4,7,8,9-HpCDF		BDL	BDL	BDL	BDL
µg/dscm	0.63	1.24E-07	1.60E-07	3.36E-07	2.07E-07
lb/hr		1.81E-11	2.28E-11	4.81E-11	2.97E-11
OCDF		ADL	BDL	BDL	DLL
µg/dscm	0.70	2.38E-07	2.22E-07	1.25E-07	1.95E-07
lb/hr		3.48E-11	3.16E-11	1.79E-11	2.81E-11

	Detection Limit, pg	Run No.			Average
		P-CARB-1	P-CARB-2	P-CARB-3	
Start Time/Date		10:26, 09/12/2016	13:39, 09/13/2016	16:35, 09/14/2016	
End Time/Date		12:20, 09/13/2016	16:17, 09/14/2016	23:40, 09/15/2016	
Total Furans		DLL	DLL	DLL	DLL
µg/dscm	NA	3.23E-06	2.99E-06	2.30E-06	2.84E-06
lb/hr		4.72E-10	4.25E-10	3.30E-10	4.09E-10
Naphthalene		ADL	ADL	ADL	ADL
µg/dscm	7510	8.02E+00	1.15E+01	3.12E+00	7.54E+00
lb/hr		1.17E-03	1.63E-03	4.46E-04	1.08E-03
Acenaphthylene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.61E-01	3.75E-01	1.68E-01	2.35E-01
lb/hr		2.35E-05	5.34E-05	2.40E-05	3.36E-05
Acenaphthene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.72E-02	6.91E-02	2.43E-02	4.02E-02
lb/hr		3.96E-06	9.83E-06	3.47E-06	5.76E-06
Fluorene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.85E-01	4.86E-01	1.92E-01	2.88E-01
lb/hr		2.70E-05	6.92E-05	2.74E-05	4.12E-05
Phenanthrene		ADL	ADL	ADL	ADL
µg/dscm	8610	5.81E-01	1.38E+00	4.90E-01	8.16E-01
lb/hr		8.49E-05	1.96E-04	7.01E-05	1.17E-04
Anthracene		ADL	ADL	ADL	ADL
µg/dscm	6000	7.82E-02	2.10E-01	9.22E-02	1.27E-01
lb/hr		1.14E-05	2.99E-05	1.32E-05	1.82E-05
Fluoranthene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.74E-01	4.20E-01	1.48E-01	2.47E-01
lb/hr		2.55E-05	5.97E-05	2.12E-05	3.55E-05
Pyrene		ADL	ADL	ADL	ADL
µg/dscm	6000	7.34E-02	2.10E-01	6.53E-02	1.16E-01
lb/hr		1.07E-05	2.99E-05	9.34E-06	1.66E-05
Benzo(a)Anthracene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.11E-02	5.01E-02	1.39E-01	2.48E-02
lb/hr		3.09E-06	7.13E-06	1.99E-06	4.07E-06
Chrysene		ADL	ADL	ADL	ADL
µg/dscm	6000	4.86E-02	1.10E-01	3.05E-02	6.31E-02
lb/hr		7.10E-06	1.57E-05	4.36E-06	9.05E-06
Benzo(b)Fluoranthene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.96E-02	6.10E-02	1.79E-02	3.62E-02
lb/hr		4.33E-06	8.68E-06	2.56E-06	5.19E-06
Benzo(k)Fluoranthene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.48E-02	5.21E-02	1.39E-02	3.03E-02
lb/hr		3.62E-06	7.41E-06	1.99E-06	4.34E-06
Benzo(a)Pyrene		ADL	ADL	ADL	ADL
µg/dscm	6000	7.44E-03	1.90E-02	3.91E-03	1.01E-02
lb/hr		1.09E-06	2.70E-06	5.60E-07	1.45E-06

	Detection Limit, pg	Run No.			Average
		P-CARB-1	P-CARB-2	P-CARB-3	
Start Time/Date		10:26, 09/12/2016	13:39, 09/13/2016	16:35, 09/14/2016	
End Time/Date		12:20, 09/13/2016	16:17, 09/14/2016	23:40, 09/15/2016	
Perylene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.19E-03	4.57E-03	1.44E-03	2.73E-03
lb/hr		3.21E-07	6.50E-07	2.06E-07	3.92E-07
Indeno(1,2,3-cd)Pyrene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.82E-02	4.05E-02	5.67E-03	2.14E-02
lb/hr		2.65E-06	5.76E-06	8.10E-07	3.07E-06
Dibenzo(a,h)Anthracene		ADL	ADL	ADL	ADL
µg/dscm	6000	6.10E-03	6.15E-03	5.88E-03	6.04E-03
lb/hr		8.91E-07	8.75E-07	8.41E-07	8.69E-07
Benzo(ghi)Perylene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.18E-02	2.35E-02	5.21E-03	1.35E-02
lb/hr		1.73E-06	3.34E-06	7.45E-07	1.94E-06
Total PAH		ADL	ADL	ADL	ADL
µg/dscm	NA	9.47E+00	1.50E+01	4.40E+00	9.62E+00
lb/hr		1.38E-03	2.13E-03	6.29E-04	1.38E-03

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.2 Combustion Stack

The EP-3 Combustion Stack was sampled to determine the emission profile for the following pollutants: filterable particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), hydrogen sulfide (H_2S), hydrogen chloride/hydrogen fluoride (HCL/HF), metals, condensable PM, toluene soluble organics (TSO), PM_{10}, formaldehyde, hydrogen cyanide (HCN), volatile oganic hazardous air pollutants (VOHAP), polycyclic aromatic hydrocarbons (PAH), dioxin/furans (D/F), and opacity via COMS.

The Combustion Stack has a single exhaust that was measured for all pollutants, flow, and O_2/CO_2 concentrations.

2.2.1 Stack Gas Conditions and Pollutant Emissions

2.2.1.1 Stack Gas Conditions

Table C-1 details the results of the combustion stack stack gas conditions measured during each pollutant sampling run.

Table C-1. Stack Gas Conditions at Combustion Stack

August 29-September 15, 2016 AK Steel, Middletown, Ohio

Date	Other Test Methods Performed	Stack Gas Velocity, fps[a]	Volumetric Flow Rate		Stack Temperature, °F	Moisture Content, % H_2O	CO_2, %	O_2, %
			acfm[b]	dscfm[c]				
08/29/2016	Method 6, 10, & 15	13.7	126,472	82,003	273	10.4	2.8	15.3
09/06/2016	Method 5/29	13.7	126,975	78,619	298	10.2	3.0	15.0
09/07/2016	Method 5/29	13.5	124,885	78,747	292	10.8	3.7	14.2
09/08/2016	Method 26	14.3	132,223	74,800	371	11.1	3.8	13.7
09/12/2016	Carb 428/429	13.7	126,901	74,952	360	8.9	3.4	14.6
09/13/2016	Carb 428/429	14.2	130,997	76,477	362	9.6	3.6	14.4
09/14/2016	Carb 428/429	14.2	130,794	75,905	357	10.8	3.7	14.1
09/15/2016	Method 316	14.3	131,819	76,731	356	10.8	4.0	12.4

[a]Feet per second.
[b]Actual cubic feet per minute.
[c]Dry standard cubic feet per minute.

2.2.1.2 PM/Metals (Sb, As, Be, Cd, Cr, Co, Pb, Mn, Hg, Ni, Se)

Table C-2 details Combustion Stack exhaust conditions measured under each PM/Metals test run. Continuous samples were collected during each run and analyzed via Method 3A for O_2 and CO_2 composition. The PM and metals results are reported in the units specified in the ICR: µg/dscm, lb/hr, and lb/ton of metal produced.

2.2.1.3 Total PM (Filterable and Condensable)

Table C-3 details the combustion stack exhaust conditions measured under each filterable condensable PM test run. Results are summarized for concentration (mg/dscm) and mass emission rate (lb/hr).

2.2.1.4 HCl/HF/HCN

Table C-4 details the combustion stack exhaust conditions measured under each HCl/HF test run. The HCl/HF/HCN results are reported in the units specified in the ICR: mg/dscm, ppm and lb/hr.

2.2.1.5 Sulfur Dioxide, Carbon Monoxide and Hydrogen Sulfide

Table C-5 details the combustion stack exhaust conditions measured under each SO_2, CO, and H_2S test run. Results are summarized for concentration (ppm) and mass rate (lb/hr).

Table C-2. Summary of Combustion Stack: PM and Metals

September 6-7, 2016 AK Steel, Middletown, Ohio

	Detection Limit, µg	Run No.			Average
		C-29-1	C-29-2	C-29-3	
Date		9/06/2016	9/07/2016	9/07/2016	
Start/End Time		10:02-13:02	08:40-11:40	12:30-15:30	
Filt. PM		ADL	ADL	ADL	ADL
mg/dscm	400	87.2	49.1	64.7	67.0
lb/hr		25.69	14.40	19.19	19.76
Antimony		BDL	DLL	BDL	DLL
µg/dscm	0.2	5.67E-02	4.70E-01	6.29E-02	1.97E-01
lb/hr		1.67E-05	1.38E-04	1.86E-05	5.76E-05
Arsenic		ADL	ADL	ADL	ADL
µg/dscm	1.0	2.03E+00	2.19E+00	2.60E+00	2.27E+00
lb/hr		5.97E-04	6.41E-04	7.70E-04	6.69E-04
Beryllium		BDL	BDL	BDL	BDL
µg/dscm	0.2	5.67E-02	5.63E-02	5.47E-02	5.59E-02
lb/hr		1.67E-06	1.65E-05	1.62E-05	1.64E-05
Cadmium		DLL	DLL	DLL	DLL
µg/dscm	0.1	2.84E-02	2.87E-02	2.98E-02	2.90E-02
lb/hr		8.34E-06	8.41E-06	8.82E-06	8.52E-06
Chromium		ADL	ADL	ADL	ADL
µg/dscm	1.0	5.46E+00	5.27E+00	5.12E+00	5.28E+00
lb/hr		1.60E-03	1.54E-03	1.52E-03	1.55E-03
Cobalt		DLL	DLL	DLL	DLL
µg/dscm	0.2	6.27E-02	3.80E-02	6.26E-02	5.44E-02
lb/hr		1.84E-05	1.11E-05	1.85E-05	1.60E-05
Lead		ADL	ADL	ADL	ADL
µg/dscm	0.5	2.97E+00	2.07E+00	3.49E+00	2.84E+00
lb/hr		8.72E-04	6.05E-04	1.03E-03	8.37E-04
Manganese		ADL	ADL	ADL	ADL
µg/dscm	0.5	3.69E+00	3.55E+00	1.57E+00	2.94E+00
lb/hr		1.08E-03	1.04E-03	4.65E-04	8.62E-04
Mercury		DLL	DLL	DLL	DLL
µg/dscm	0.12	1.46E-01	1.24E-01	2.65E-01	1.78E-01
lb/hr		4.28E-05	3.64E-05	7.84E-05	5.26E-05
Nickel		ADL	ADL	ADL	ADL
µg/dscm	0.2	4.78E+00	4.38E+00	2.72E+00	3.96E+00
lb/hr		1.40E-03	1.28E-03	8.04E-04	1.16E-03
Selenium		DLL	DLL	DLL	DLL
µg/dscm	2.0	4.82E+00	3.32E+00	3.47E+00	3.87E+00
lb/hr		1.42E-03	9.73E-04	1.03E-03	1.14E-03

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

Table C-3. Summary of Combustion Stack: Total Particulate

September 6-7, 2016 AK Steel, Middletown, Ohio

	Detection Limit, Mg	Run No. C-202-1	C-202-2	C-202-3	Average
Date		9/06/2016	9/07/2016	9/07/2016	
Start/End Time		10:02-14:09	08:35-11:54	12:25-16:11	
<$PM_{2.5}$		ADL	ADL	ADL	ADL
mg/dscm	0.4	25.3	26.4	4.7	18.8
lb/hr		8.09	7.85	1.32	5.75
<PM_{10}		ADL	ADL	ADL	ADL
mg/dscm	0.4	27.9	30.3	7.6	21.9
lb/hr		8.94	9.02	2.12	6.69
Total Filterable PM		ADL	ADL	ADL	ADL
mg/dscm	0.4	29.2	33.4	11.3	24.6
lb/hr		9.53	9.95	3.15	7.54
Condensable PM		ADL	ADL	ADL	ADL
mg/dscm	0.4	13.2	15.0	33.2	20.5
lb/hr		4.24	4.48	9.28	6.00
Total PM		ADL	ADL	ADL	ADL
mg/dscm	0.4	42.4	48.4	44.5	45.1
lb/hr		13.58	14.43	12.43	13.48

Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

Table C-4. Summary of Combustion Stack: Hydrogen Chloride, Hydrogen Fluoride, and Hydrogen Cyanide

September 6 & 8, 2016 AK Steel, Middletown, Ohio

	Detection Limit, mg	Run No. C-26-1	C-26-2	C-26-3	Average
Date		9/06/2016	9/08/2016	9/08/2016	
Time		14:50-16:02	10:08-11:08	11:55-12:55	
Hydrogen Chloride (HCl)	0.071	ADL	ADL	ADL	ADL
mg/dscm		1.03E+01	5.94E+00	7.83E+00	8.01E+00
lb/hr		2.94E+00	1.67E+00	2.18E+00	2.26E+00
Hydrogen Fluoride (HF)	0.1	ADL	ADL	ADL	ADL
mg/dscm		2.91E-01	2.71E-01	2.59E-01	2.74E-01
lb/hr		8.34E-02	7.61E-02	7.20E-02	7.72E-02
Hydrogen Cyanide (HCN)	0.1	ADL	ADL	ADL	ADL
mg/dscm		4.11E-01	3.97E-01	5.79E-01	4.62E-01
lb/hr		1.24E-01	1.03E-01	1.37E-01	1.21E-01

Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

Table C-5. Summary of Combustion Stack: Hydrogen Sulfide, Sulfur Dioxide, and Carbon Monoxide

August 29, 2016 AK Steel, Middletown, Ohio

	Detection Limit, ppb	Run No. C-15-1	Run No. C-15-2	Run No. C-15-3	Average
Date		8/29/2016	8/29/2016	8/29/2016	
Time		10:24-11:09	11:35-12:20	12:45-13:30	
Hydrogen Sulfide (H_2S)	50	ADL	ADL	ADL	ADL
ppm		6.10E-03	1.60E-02	4.90E-02	2.37E-02
lb/hr		2.78E-03	6.85E-03	2.03E-02	1.01E-02
Sulfur Dioxide (SO_2)	1000	ADL	ADL	ADL	ADL
ppm		253.5	230.2	225.3	236.3
lb/hr		216.82	184.93	175.20	193.38
Carbon Monoxide (CO)	1000	ADL	ADL	ADL	ADL
ppm		56.1	65.1	87.3	69.5
lb/hr		20.98	22.87	29.70	24.70

Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.2.1.6 Toluene Soluble Organics

Table C-6 details the combustion stack exhaust conditions measured under each TSO test run. Results are summarized for concentration (mg/dscm) and mass emission rate (lb/hr).

Table C-6. Summary of Combustion Stack: Toluene Soluble Organic Particulate Matter

September 12-14, 2016 AK Steel, Middletown, Ohio

	Detection Limit, mg	Run No. C-315-1	Run No. C-315-2	Run No. C-315-3	Average
Date		9/12/ 2016	9/13/2016	9/14/2016	
Time		1005-1215	0955-1155	0955-1155	
PM	0.4	DLL	DLL	DLL	DLL
mg/dscm		31.63	25.02	52.26	36.30
lb/hr		8.93	7.24	14.83	10.33
MCEM	0.4	DLL	DLL	DLL	DLL
mg/dscm		2.35	6.05	14.64	7.68
lb/hr		0.66	1.75	4.15	2.19

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.

2.2.1.7 Volatile Organic Hazardous Air Pollutants

Table C-7 details the combustion stack exhaust conditions measured under each SW846 0031 sampling run for VOHAP. Individual compounds are summarized by their emissions as concentrations (mg/dscm) and mass emission rates (lb/hr). Run 3 was voided due to a process upset.

Table C-7. Summary of Combustion Stack: Speciated Volatile Organic HAPs (VOHAP)

September 8 and 15, 2016 AK Steel, Middletown, Ohio

	Detection Limit, µg	Run No. C-0031-1	C-0031-2	C-0031-4	Average
Date		9/8/16	9/8/16	9/15/16	
Time		0935-1235	1245-1532	0945-1248	
Chloromethane		BDL	BDL	BDL	BDL
mg/dscm	0.06	3.58E-02	3.70E-02	3.54E-02	3.60E-02
lb/hr		8.93E-03	9.17E-03	1.00E-02	9.38E-03
Vinyl Chloride		BDL	BDL	BDL	BDL
mg/dscm	0.02	1.19E-02	1.23E-02	1.18E-02	1.20E-02
lb/hr		2.98E-03	3.06E-03	3.34E-03	3.13E-03
Bromomethane		BDL	BDL	BDL	BDL
mg/dscm	0.09	5.36E-02	5.55E-02	5.30E-02	5.41E-02
lb/hr		1.34E-02	1.38E-02	1.50E-02	1.41E-02
Chloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.02	1.19E-02	1.23E-02	1.18E-02	1.20E-02
lb/hr		2.98E-03	3.06E-03	3.34E-03	3.13E-03
1,1-Dichloroethene		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
Iodomethane		BDL	BDL	BDL	BDL
mg/dscm	0.03	1.79E-02	1.85E-02	1.77E-02	1.80E-02
lb/hr		4.46E-03	4.59E-03	5.02E-03	4.69E-03
Carbon Disulfide		DLL	DLL	DLL	DLL
mg/dscm	0.02	1.21E-02	1.23E-02	6.28E-02	2.91E-02
lb/hr		3.01E-03	3.06E-03	1.78E-02	7.62E-03
Methylene Chloride		BDL	DLL	DLL	DLL
mg/dscm	0.1	5.96E-02	6.57E-02	1.70E-01	9.83E-02
lb/hr		1.49E-02	1.63E-02	4.81E-02	2.59E-02
Chloroform		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
1,1,1-Trichloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03

	Detection Limit, µg	Run No. C-0031-1	C-0031-2	C-0031-4	Average
Date		9/8/16	9/8/16	9/15/16	
Time		0935-1235	1245-1532	0945-1248	
Carbon Tetrachloride		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
Benzene		ADL	ADL	ADL	ADL
mg/dscm	0.5	1.08E+00	1.88E+00	4.92E+00	2.45E+00
lb/hr		2.69E-01	2.68E-01	1.40E+00	6.70E-01
1,2-Dichloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
Trichloroethene		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
1,2-Dichloropropane		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
Toluene		DLL	DLL	DLL	DLL
mg/dscm	0.05	1.06E-01	1.04E-01	1.45E+00	3.88E-01
lb/hr		2.64E-02	2.59E-02	4.11E-01	1.08E-01
1,1,2-Trichloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.02	1.19E-02	1.23E-02	1.18E-02	1.20E-02
lb/hr		2.98E-03	3.06E-03	3.34E-03	3.13E-03
Tetrachloroethene		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
Chlorobenzene		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
Ethylbenzene		DLL	DLL	DLL	DLL
mg/dscm	0.01	6.89E-03	6.22E-03	1.11E-02	8.07E-03
lb/hr		1.72E-03	1.54E-03	3.15E-03	2.14E-03
M&P Xylene		DLL	DLL	DLL	DLL
mg/dscm	0.03	3.99E-02	2.40E-02	1.57E-01	7.35E-02
lb/hr		9.95E-03	5.94E-03	4.45E-02	2.01E-02
O-Xylene		DLL	DLL	DLL	DLL
mg/dscm	0.01	1.03E-02	7.12E-03	3.09E-02	1.61E-02
lb/hr		2.58E-03	1.76E-03	8.76E-03	4.37E-03
Styrene		DLL	DLL	DLL	DLL
mg/dscm	0.02	1.76E-02	1.42E-02	5.00E-02	2.73E-02
lb/hr		4.38E-03	3.53E-03	1.42E-02	7.37E-03
Bromoform		BDL	BDL	BDL	BDL
mg/dscm	0.01	5.96E-03	6.17E-03	5.89E-03	6.01E-03
lb/hr		1.49E-03	1.53E-03	1.67E-03	1.56E-03
1,1,2,2-Tetrachloroethane		BDL	BDL	BDL	BDL
mg/dscm	0.02	1.19E-02	1.23E-02	1.18E-02	1.23E-02
lb/hr		2.98E-03	3.06E-03	3.34E-03	3.06E-03

	Detection Limit, µg	Run No.			Average
		C-0031-1	C-0031-2	C-0031-4	
Date		9/8/16	9/8/16	9/15/16	
Time		0935-1235	1245-1532	0945-1248	
Acrylonitrile	0.05	BDL	BDL	BDL	BDL
mg/dscm		2.98E-02	3.08E-02	2.95E-02	3.00E-02
lb/hr		7.44E-03	7.65E-03	8.36E-03	7.82E-03
Formaldehyde	2.5	BDL	BDL	BDL	BDL
mg/dscm		2.42E-03	2.41E-03	2.11E-03	2.31E-03
lb/hr		6.04E-04	5.97E-04	6.06E-04	6.02E-04

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.2.1.8 PCBs, D/F and PAHs

Table C-8 details the combustion stack exhaust conditions measured under each CARB Method 428 sampling run for PCBs, D/Fs, and PAHs. The results are reported in the units specified in the ICR: µg/dscm and lb/hr.

Table C-8. Summary of Combustion Stack: Semi-Volatile Organic HAPs (VOHAP)

September 12-14, 2016 AK Steel, Middletown, Ohio

	Detection Limit, pg	Run No.			Average
		C-CARB-1	C-CARB-2	C-CARB-3	
Date		9/12/2016	9/13/2016	9/14/2016	
Time		10:05-14:05	09:55-13:55	09:55-13:55	
2,3,7,8-TCDD	0.99	BDL	BDL	BDL	BDL
µg/dscm		1.87E-07	2.09E-07	3.28E-07	2.41E-07
lb/hr		5.24E-11	5.97E-11	9.30E-11	6.84E-11
1,2,3,7,8-PeCDD	0.72	ADL	ADL	ADL	ADL
µg/dscm		1.03E-06	1.44E-06	1.25E-06	1.24E-06
lb/hr		2.89E-10	4.13E-10	3.55E-10	3.52E-10
1,2,3,4,7,8-HxCDD	0.97	ADL	BDL	BDL	DLL
µg/dscm		4.05E-07	1.06E-06	5.68E-07	6.76E-07
lb/hr		1.13E-10	3.02E-10	1.61E-10	1.92E-10
1,2,3,6,7,8-HxCDD	0.87	BDL	BDL	ADL	DLL
µg/dscm		1.67E-06	9.46E-07	2.36E-06	1.66E-06
lb/hr		4.68E-10	2.70E-10	6.70E-10	4.69E-10
1,2,3,7,8,9-HxCDD	0.96	BDL	BDL	BDL	BDL
µg/dscm		7.69E-07	1.06E-06	1.25E-06	1.02E-06
lb/hr		2.16E-10	3.02E-10	3.54E-10	2.90E-10
1,2,3,4,6,7,8-HpCDD	0.99	ADL	ADL	ADL	ADL
µg/dscm		4.88E-06	4.82E-06	6.08E-06	5.26E-06
lb/hr		1.37E-09	1.38E-09	1.72E-09	1.49E-09

	Detection Limit, pg	Run No.			
		C-CARB-1	C-CARB-2	C-CARB-3	
Date		9/12/2016	9/13/2016	9/14/2016	
Time		10:05-14:05	09:55-13:55	09:55-13:55	Average
OCDD		ADL	ADL	ADL	ADL
µg/dscm	3.77	4.62E-06	5.01E-06	5.99E-06	5.21E-06
lb/hr		1.29E-09	1.43E-09	1.70E-09	1.48E-09
Total Dioxins		DLL	DLL	DLL	DLL
µg/dscm	NA	1.36E-05	1.45E-05	1.78E-05	1.53E-05
lb/hr		3.80E-09	4.16E-09	5.06E-09	4.34E-09
2,3,7,8-TCDF		ADL	ADL	ADL	ADL
µg/dscm	0.59	2.35E-06	1.32E-06	2.23E-06	1.97E-06
lb/hr		6.59E-10	3.78E-10	6.33E-10	5.57E-10
1,2,3,7,8-PeCDF		ADL	ADL	ADL	ADL
µg/dscm	1.2	2.13E-06	1.56E-06	1.90E-06	1.86E-06
lb/hr		5.98E-10	4.46E-10	5.39E-10	5.28E-10
2,3,4,7,8-PeCDF		ADL	ADL	ADL	ADL
µg/dscm	0.35	2.22E-06	1.75E-06	1.18E-06	1.72E-06
lb/hr		6.22E-10	5.01E-10	3.35E-10	4.86E-10
1,2,3,4,7,8-HxCDF		ADL	ADL	ADL	ADL
µg/dscm	0.52	2.84E-06	3.54E-06	3.37E-06	3.25E-06
lb/hr		7.95E-10	1.01E-09	9.55E-10	9.21E-10
1,2,3,6,7,8-HxCDF		ADL	BDL	BDL	DLL
µg/dscm	0.47	1.19E-06	7.48E-07	9.18E-07	9.53E-07
lb/hr		3.34E-10	2.14E-10	2.61E-10	2.69E-10
2,3,4,6,7,8-HxCDF		ADL	BDL	BDL	DLL
µg/dscm	0.51	5.10E-07	5.72E-07	6.56E-07	5.79E-07
lb/hr		1.43E-10	1.63E-10	1.86E-10	1.64E-10
1,2,3,7,8,9-HxCDF		ADL	BDL	BDL	DLL
µg/dscm	1.3	4.66E-07	7.04E-07	5.25E-07	5.65E-07
lb/hr		1.31E-10	2.01E-10	1.49E-10	1.60E-10
1,2,3,4,6,7,8-HpCDF		ADL	ADL	ADL	ADL
µg/dscm	0.58	3.03E-06	2.82E-06	3.24E-06	3.03E-06
lb/hr		8.50E-10	8.05E-10	9.18E-10	8.58E-10
1,2,3,4,7,8,9-HpCDF		ADL	BDL	ADL	DLL
µg/dscm	0.63	4.33E-07	4.62E-07	5.51E-07	4.82E-07
lb/hr		1.21E-10	1.32E-10	1.56E-10	1.37E-10
OCDF		ADL	ADL	ADL	ADL
µg/dscm	0.70	2.35E-06	2.20E-06	3.17E-06	2.57E-06
lb/hr		6.59E-10	6.29E-10	8.99E-10	7.29E-10
Total Furans		DLL	DLL	DLL	DLL
µg/dscm	NA	1.75E-05	1.57E-05	1.77E-05	1.70E-05
lb/hr		4.91E-09	4.48E-09	5.03E-09	4.81E-09
Naphthalene		ADL	ADL	ADL	ADL
µg/dscm	7510	1.61E+02	9.79E+01	2.40E+02	1.66E+02
lb/hr		4.50E-02	2.80E-02	6.82E-02	4.71E-02
Acenaphthylene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.53E+01	1.05E+00	2.30E+01	1.31E+01
lb/hr		4.27E-03	2.99E-04	6.51E-03	3.70E-03

	Detection Limit, pg	Run No.			
		C-CARB-1	C-CARB-2	C-CARB-3	
Date		9/12/2016	9/13/2016	9/14/2016	
Time		10:05-14:05	09:55-13:55	09:55-13:55	Average
Acenaphthene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.19E-01	1.07E-01	2.91E-01	2.06E-01
lb/hr		6.14E-05	3.05E-05	8.25E-05	5.81E-05
Fluorene		ADL	ADL	ADL	ADL
µg/dscm	6000	3.17E+00	9.28E-01	5.12E+00	3.07E+00
lb/hr		8.87E-04	2.65E-04	1.45E-03	8.68E-04
Phenanthrene		ADL	ADL	ADL	ADL
µg/dscm	8610	2.62E+01	3.54E+00	4.37E+01	2.45E+01
lb/hr		7.33E-03	1.01E-03	1.24E-02	6.92E-03
Anthracene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.46E+00	2.05E-01	3.26E+00	1.64E+00
lb/hr		4.10E-04	5.86E-05	9.24E-04	4.64E-04
Fluoranthene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.52E+01	1.20E+00	2.27E+01	1.31E+01
lb/hr		4.26E-03	3.44E-04	6.45E-03	3.69E-03
Pyrene		ADL	ADL	ADL	ADL
µg/dscm	6000	7.39E+00	3.15E-01	2.40E+01	1.06E+01
lb/hr		2.07E-03	8.99E-05	6.82E-03	2.99E-03
Benzo(a)Anthracene		ADL	ADL	ADL	ADL
µg/dscm	6000	6.46E-01	6.33E-02	1.45E+00	7.20E-01
lb/hr		1.81E-04	1.81E-05	4.12E-04	2.04E-04
Chrysene		ADL	ADL	ADL	ADL
µg/dscm	6000	2.88E+00	2.73E-01	4.11E+00	2.42E+00
lb/hr		8.07E-04	7.80E-05	1.17E-03	6.84E-04
Benzo(b)Fluoranthene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.92E+00	1.66E-01	3.76E+00	1.95E+00
lb/hr		5.38E-04	4.74E-05	1.07E-03	5.51E-04
Benzo(k)Fluoranthene		ADL	ADL	ADL	ADL
µg/dscm	6000	7.43E-01	4.22E-02	1.59E+00	7.92E-01
lb/hr		2.08E-04	1.21E-05	4.51E-04	2.24E-04
Benzo(a)Pyrene		ADL	ADL	ADL	ADL
µg/dscm	6000	1.65E-02	1.78E-03	7.41E-02	3.08E-02
lb/hr		4.63E-06	5.09E-07	2.10E-05	8.72E-06
Perylene		BDL	BDL	ADL	DLL
µg/dscm	6000	1.32E-03	1.32E-03	7.74E-03	3.46E-03
lb/hr		3.70E-07	3.77E-07	2.20E-06	9.81E-07
Indeno(1,2,3-cd)Pyrene		ADL	ADL	ADL	ADL
µg/dscm	6000	8.44E-02	1.88E-02	2.21E-01	1.08E-01
lb/hr		2.37E-05	5.39E-06	6.26E-05	3.06E-05
Dibenzo(a,h)Anthracene		ADL	ADL	ADL	ADL
µg/dscm	6000	6.97E-02	1.20E-02	1.43E-01	7.50E-02
lb/hr		1.95E-05	3.43E-06	4.06E-05	2.12E-05
Benzo(ghi)Perylene		ADL	ADL	ADL	ADL
µg/dscm	6000	3.56E-02	1.62E-02	1.61E-01	7.09E-02
lb/hr		9.98E-06	4.63E-06	4.57E-05	2.01E-05
Total PAH		DLL	DLL	ADL	DLL
µg/dscm	NA	2.36E+02	1.06E+02	3.74E+02	2.39E+02
lb/hr		6.61E-02	3.02E-02	1.06E-01	6.75E-02

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.3 Quench Tower

The EP-10 Quench Tower water was sampled to determine the emission profile for the following pollutants: pH, total dissolved solids (TDS) (EPA Method 160.1), HAP metals (EPA Method 200.7), HCl (Standard Method 4500-Cl^-), HCN (Standard Method 4500-CN^-), HF (Standard Method 4500-F^-), total sulfide (Standard Method 4500-$S2^-$ Sulfide), Semi-volatiles (EPA Method 610 and 1613B), total sulfate (SW 846 Method 905A), and VOHAP (EPA Method 602 & 624, SW846 8260B).

2.3.1 Metals

Table Q-1 details the metals emissions from the Quench tower. Analysis was performed using EPA Method 200.7 and 245.1 (mercury only). Each day's emissions are the average of the 3 composite samples taken each day.

Table Q-1. Summary of Quench Tower – Metals

August 30-September 1, 2016 AK Steel, Middletown, Ohio

		Run No.			
		Q--1	**Q--2**	**Q--3**	
Date	**Detection**	08/30/2016	08/31/2016	09/01/2016	
Sampling Times	**Limit, µg/m^3**	10:30, 13:05, 16:20	10:30, 13:03, 16:21	10:30, 13:00, 16:20	**Average**
Antimony µg/m^3	3100	DLL 9767	DLL 7100	DLL 7800	DLL 8222
Arsenic µg/m^3	3300	ADL 63667	ADL 52667	ADL 63333	ADL 59889
Beryllium µg/m^3	210	DLL 567	DLL 1893	DLL 463	DLL 974
Cadmium µg/m^3	290	DLL 493	DLL 2000	DLL 1460	DLL 1318
Chromium µg/m^3	550	DLL 3600	DLL 2300	DLL 5433	DLL 3778
Cobalt µg/m^3	840	DLL 2000	DLL 1167	DLL 2033	DLL 1733
Lead µg/m^3	1900	DLL 4333	DLL 5000	DLL 5000	DLL 4778
Manganese µg/m^3	5100	ADL 51000	ADL 52667	ADL 74667	ADL 59444
Mercury µg/m^3	90	BDL 200	BDL 200	BDL 200	BDL 200
Nickel µg/m^3	1600	DLL 10367	DLL 6900	DLL 10833	DLL 9522
Selenium µg/m^3	5100	DLL 7100	DLL 8400	DLL 6767	DLL 7311

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.3.2 Total Sulfates and Sulfides

Table Q-2 details the total sulfate and sulfide from the Quench tower. Each day's concentrations are the average of the 3 composite samples taken each day.

Table Q-2. Summary of Quench Tower – Total Sulfate and Total Sulfide

August 30-September 1, 2016 AK Steel, Middletown, Ohio

		Run No.			
		Q--1	Q--2	Q--3	
Date	**Detection**	08/30/2016	08/31/2016	09/01/2016	
Time	**Limit, mg/L**	10:30, 13:05, 16:20	10:30, 13;03, 16:21	10:30, 13:00, 16:20	**Average**
Total Sulfate mg/L	0.65	ADL 3.10E+02	ADL 3.03E+02	ADL 2.97E+02	ADL 3.03E+02
Total Sulfide mg/L	0.41	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.3.3 Hydrogen Chloride, Hydrogen Fluoride, and Hydrogen Cyanide

Table Q-3 details the hydrogen chloride, hydrogen fluoride, and hydrogen cyanide concentrations. Each day's concentrations are the average of the 3 composite samples taken each day.

Table Q-3. Summary of Quench Tower – Hydrogen Chloride, Hydrogen Fluoride, and Hydrogen Cyanide

August 30-September 1, 2016 AK Steel, Middletown, Ohio

		Run No.			
		Q--1	Q--2	Q--3	
Date	**Detection**	08/30/2016	08/31/2016	09/01/2016	
Time	**Limit, mg/L**	10:30, 13:05, 16:20	10:30, 13:03, 16:21	10:30, 13:00, 16:20	**Average**
Hydrogen Chloride (HCl) mg/L	2.0	ADL 2.73E+02	ADL 2.73E+02	ADL 2.63E+02	ADL 2.70E+02
Hydrogen Fluoride (HF) mg/L	0.009	DLL 7.67E-01	DLL 8.40E-01	DLL 8.67E-01	DLL 8.24E-01
Hydrogen Cyanide (HCN) mg/L	0.005	DLL 1.00E-02	DLL 1.00E-02	DLL 7.90E-03	DLL 9.30E-03

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.3.4 VOHAP

Table Q-4 details the speciated volatile organic HAP concentrations. Each day's concentrations are the average of the 3 composite samples taken each day.

Table Q-4. Summary of Quench Tower – Speciated Volatile Organic HAPs (VOHAP)

August 30-September 1, 2016 AK Steel, Middletown, Ohio

		Run No.			
		Q--1	**Q--2**	**Q--3**	
Date	**Detection**	08/30/2016	08/31/2016	09/01/2016	
Time	**Limit, µg/L**	10:30, 13:05, 16:20	103:0, 13:03, 16:21	10:30, 13:00, 16:20	**Average**
Chloromethane µg/L	0.44	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Vinyl Chloride µg/L	0.29	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Bromomethane µg/L	0.44	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Chloroethane µg/L	0.32	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
1,1-Dichloroethene µg/L	0.45	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Iodomethane µg/L	0.42	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Carbon Disulfide µg/L	0.38	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Methylene Chloride µg/L	0.33	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Chloroform µg/L	0.25	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
1,1,1-Trichloroethane µg/L	0.44	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Carbon Tetrachloride µg/L	0.43	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Benzene µg/L	0.35	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
1,2-Dichloroethane µg/L	0.23	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Trichloroethene µg/L	0.22	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
1,2-Dichloropropane µg/L	0.25	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Toluene µg/L	0.23	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00

		Run No.			
		Q--1	Q--2	Q--3	
Date	**Detection**	08/30/2016	08/31/2016	09/01/2016	
Time	**Limit, µg/L**	10:30, 13:05, 16:20	103:0, 13:03, 16:21	10:30, 13:00, 16:20	**Average**
1,1,2-Trichloroethane µg/L	0.24	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Tetrachloroethene µg/L	0.31	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Chlorobenzene µg/L	0.25	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Ethylbenzene µg/L	0.25	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Xylenes µg/L	0.52	BDL 2.00	BDL 2.00	BDL 2.00	BDL 2.00
Styrene µg/L	0.45	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Bromoform µg/L	0.56	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
1,1,2,2-Tetrachloroethane µg/L	0.22	BDL 1.00	BDL 1.00	BDL 1.00	BDL 1.00
Acrylonitrile µg/L	6.3	BDL 20.0	BDL 20.0	BDL 20.0	BDL 20.0
Formaldehyde µg/L	10	BDL 50	BDL 50	BDL 50	BDL 50

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.3.5 Semi-Volatile HAPs

Table Q-5 details the semi-volatile HAPs and PAH concentrations. Each day's concentrations are the average of the 3 composite samples taken each day.

Table Q-5. Summary of Quench Tower – Semi-Volatile Organic HAPs

August 30-September 1, 2016 AK Steel, Middletown, Ohio

		Run No.			
		Q--1	Q--2	Q--3	
Date	**Detection**	08/30/2016	08/31/2016	09/01/2016	
Time	**Limit, µg/m³**	10:30, 13:05, 16:20	10:30, 13:03, 16:21	10:30, 13:00, 16:20	**Average**
Naphthalene µg/m³	450	BDL 933	BDL 930	BDL 930	BDL 931
Acenaphthylene µg/m³	210	BDL 933	BDL 930	BDL 930	BDL 931
Acenaphthene µg/m³	460	BDL 933	BDL 673	BDL 747	BDL 784
Fluorene µg/m³	350	BDL 328	BDL 470	BDL 470	BDL 423
Phenanthrene µg/m³	320	BDL 140	BDL 202	BDL 210	BDL 184
Anthracene µg/m³	320	BDL 933	BDL 933	BDL 660	BDL 841
Fluoranthene µg/m³	280	DLL 230	DLL 247	DLL 367	DLL 281
Pyrene µg/m³	290	DLL 154	DLL 333	DLL 273	DLL 254
Benzo(a)Anthracene µg/m³	610	BDL 125	BDL 71	DLL 186	DLL 127
Chrysene µg/m³	360	DLL 119	ADL 130	DLL 354	DLL 201
Benzo(b)Fluoranthene µg/m3	610	DLL 103	DLL 97	DLL 257	DLL 153
Benzo(k)Fluoranthene µg/m³	500	BDL 116	BDL 102	DLL 123	DLL 114
Benzo(a)Pyrene µg/m³	310	DLL 140	DLL 90	DLL 331	DLL 187
Perylene µg/m³	890	BDL 9400	BDL 9300	BDL 9400	BDL 9400
Indeno(1,2,3-cd)Pyrene µg/m³	500	BDL 133	BDL 106	DLL 240	DLL 160
Dibenzo(a,h)Anthracene µg/m³	420	BDL 190	BDL 190	BDL 177	BDL 186
Benzo(ghi)Perylene µg/m³	520	DLL 128	BDL 147	DLL 350	DLL 208

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

Table Q-6. Summary of Quench Tower – Dioxin and Furans

August 30-September 1, 2016 AK Steel, Middletown, Ohio

		Run No.			
		Q--1	Q--2	Q--3	
Date	Detection	08/30/2016	08/31/2016	09/01/2016	
Time	Limit, pg/L	10:30, 13:05, 16:20	10:30, 13:03, 16:21	10:30, 13:00, 16:20	Average
2,3,7,8-TCDD	6.4E-02	DLL	BDL	BDL	DLL
pg/L		3.74E-01	1.46E-01	1.30E-01	2.17E-01
1,2,3,7,8-PeCDD	8.8E-02	DLL	DLL	BDL	DLL
pg/L		1.53E-01	2.57E-01	1.20E-01	1.77E-01
1,2,3,4,7,8-HxCDD	7.7E-02	BDL	BDL	BDL	BDL
pg/L		1.36E-01	2.10E-01	1.90E-01	1.79E-01
1,2,3,6,7,8-HxCDD	7.6E-02	BDL	BDL	BDL	BDL
pg/L		1.45E-01	2.23E-01	1.97E-01	1.88E-01
1,2,3,7,8,9-HxCDD	7.2E-02	DLL	DLL	BDL	DLL
pg/L		3.64E-01	6.67E-01	1.87E-01	4.06E-01
1,2,3,4,6,7,8-HpCDD	8.8E-02	DLL	ADL	DLL	DLL
pg/L		5.67E-01	1.70E+00	4.43E-01	9.03E-01
OCDD	7.9E-02	ADL	ADL	ADL	ADL
pg/L		7.13E+00	4.20E+00	2.60E+00	4.64E+00
2,3,7,8-TCDF	8.0E-02	DLL	ADL	DLL	DLL
pg/L		3.13E-01	5.23E-01	9.83E-02	3.11E-01
1,2,3,7,8-PeCDF	6.9E-02	DLL	BDL	BDL	DLL
pg/L		2.06E-01	1.73E-01	1.43E-01	1.74E-01
2,3,4,7,8-PeCDF	6.5E-02	DLL	DLL	BDL	DLL
pg/L		2.66E-01	4.67E-01	1.33E-01	2.89E-01
1,2,3,4,7,8-HxCDF	6.3E-02	DLL	DLL	BDL	DLL
pg/L		4.27E-01	8.97E-01	1.33E-01	4.86E-01
1,2,3,6,7,8-HxCDF	5.9E-02	BDL	DLL	BDL	DLL
pg/L		1.03E-01	2.37E-01	1.33E-01	1.58E-01
2,3,4,6,7,8-HxCDF	5.8E-02	BDL	BDL	BDL	BDL
pg/L		1.06E-01	1.47E-01	1.40E-01	1.31E-01
1,2,3,7,8,9-HxCDF	7.8E-02	BDL	DLL	BDL	DLL
pg/L		1.36E-01	3.23E-01	1.73E-01	2.11E-01
1,2,3,4,6,7,8-HpCDF	7.4E-02	ADL	ADL	DLL	DLL
pg/L		1.51E+00	1.45E+00	5.17E-01	1.16E+00
1,2,3,4,7,8,9-HpCDF	1.1E-01	DLL	DLL	BDL	DLL
pg/L		2.90E-01	5.23E-01	1.47E-01	3.20E-01
OCDF	1.0E-01	ADL	ADL	ADL	ADL
pg/L		2.34E+00	2.33E+00	7.70E-01	1.81E+00

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.3.6 Total Dissolved Solids and pH

Table Q-7 details the total dissolved solids emissions and pH. Each day's concentrations are the average of the 3 composite samples taken each day.

Table Q-7. Summary of Quench Tower – Total Dissolved Solids

August 30-September 1, 2016 AK Steel, Middletown, Ohio

	Detection Limit, mg/L	Run No. Q--1	Q--2	Q--3	Average
Date		08/30/2016	08/31/2016	09/01/2016	
Time		10:30, 13:05, 16:20	10:30, 13:03, 16:21	10:30, 13:00, 16:20	
TDS	15	ADL	ADL	ADL	ADL
mg/L		960	937	1597	1164
pH	NA	8.23	8.27	8.32	8.27

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

2.4 Flare Inlet

Coke oven gas at the Flare Inlet (EP-5) was sampled for heat content using ASTM D3588. Table F-1 details the ideal gross heating values.

Table F-1. Gross Heating Values

	Sample No. 1	2	3	Average
Date	8/30/16	9/1/16	9/6/16	
Btu/ft^3	ADL	ADL	ADL	ADL
	448.2	463.4	450.9	454.2

2.5 Material Sampling

Coke oven feed (coal) and baghouse dust were sampled for mercury according to EPA SW846 Method 7471B, and coke oven gas was sampled for mercury according to ASTM D5954-98. Table MS-1 presents the mercury results for each material. Baghouse dust samples were collected each day that mercury was tested for on the Pushing Baghouse and composited into one sample for analysis.

Table MS-1. Mercury Analysis

	Detection Limit	Sample No. 1	Sample No. 2	Sample No. 3	Average
Coke Oven Feed		8/29-30/2016	8/31-9/1/2016	9/06-7/2016	
mg/kg	0.30	BDL 0.30	BDL 0.30	BDL 0.30	BDL 0.30
Baghouse Dust	8/29-31; 09/1; 9/06-7/2016 (1 sample composited over the six days)				
mg/kg	0.30	--	--	--	BDL 0.30
Coke Oven Gas		12/14/16	12/14/16	12/14/16	
µg/L	0.0005 µg	DLL 3.26E-04	ADL 3.41E-04	ADL 9.11E-04	DLL 5.26E-04

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

The baghouse dust was also analyzed for PAH/POM according to EPA SW846 Method 8100. Table MS-2 presents these results.

Table MS-2. Baghouse Dust PAH/POM

Date Sampled	Detection Limit	Sample No. 1 09/12/2016	Sample No. 2 09/13/2016	Sample No. 3 09/15/2016	Average
1-Methylnaphthalene µg/kg	910, 940, 950	ADL 1000	ADL 1100	ADL 1400	ADL 1167
2-Methylnaphthalene µg/kg	910, 940, 950	ADL 1300	ADL 1500	ADL 1900	ADL 1567
Acenaphthene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Acenaphthylene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Anthracene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Benzo(a)anthracene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Benzo(a)pyrene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Benzo(b)fluoranthene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Benzo(g,h,i)perylene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Benzo(k)fluoranthene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933

Date Sampled	Detection Limit	Sample No. 1 09/12/2016	2 09/13/2016	3 09/15/2016	Average
Carbazole µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Chrysene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Dibenzo(a,h)anthracene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Dibenzofuran µg/kg	910, 940, 950	ADL 1300	ADL 1400	ADL 950	ADL 1217
Fluoranthene µg/kg	910, 940, 950	ADL 3300	ADL 3500	ADL 2000	ADL 2933
Fluorene µg/kg	910, 940, 950	ADL 960	ADL 990	BDL 950	DLL 967
Indeno(1,2,3-cd)pyrene µg/kg	910, 940, 950	BDL 910	BDL 940	BDL 950	BDL 933
Naphthalene µg/kg	910, 940, 950	ADL 6500	ADL 7900	ADL 9300	ADL 7900
Phenanthrene µg/kg	910, 940, 950	ADL 5300	ADL 5800	ADL 3800	ADL 4967
Pyrene µg/kg	910, 940, 950	ADL 1500	ADL 1000	BDL 950	DLL 1150

Data level limited (DLL). The analytical result of a fraction of the sample is less than the analytical detection limit.
Below detection limit (BDL). The analytical result of the sample is less than the analytical detection limit.
Above detection limit (ADL). The analytical result of the sample is greater than the analytical detection limit.

3. SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used in this test program conformed to the USEPA ICR and the EPA Reference Methods as published in the *Federal Register*. A brief description of each method follows.

3.1 Location of Measurement Sites

EPA Method 1, "Sample Velocity Traverses for Stationary Sources," was used to select representative measurement sites at each sampling location. The sampling locations are described in Section 4.

3.2 Stack Gas Volumetric Flow Rate

EPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rates," was used at each location to determine stack gas volumetric flow rates. Type "S" pitot tubes meeting EPA specifications and an inclined manometer were used to measure velocity pressures. A calibrated Type "K" thermocouple attached directly to the pitot tube was used to measure stack gas temperature. The stack gas velocity was calculated from the average square root of the stack gas velocity pressure, average stack gas temperature, stack gas molecular weight, and absolute static pressure. The volumetric flow rate is the product of velocity and stack cross-sectional area.

3.3 Stack Gas Dry Molecular Weight

EPA Reference Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure)," was used to determine oxygen and carbon dioxide content of the stack gas. An analyzer that utilized a paramagnetic detector was used to measure O_2/CO_2 concentrations. The sampling system consisted of a stainless-steel probe with a glass fiber filter, a heated Teflon sampling line, and a gas conditioner prior to entering the analyzers.

3.4 Stack Gas Moisture Content

EPA Reference Method 4, “Determination of Moisture Content in Stack Gases,” was used to determine stack gas moisture content. This method was conducted in conjunction with each sampling run. The initial and final contents of all impingers were measured gravimetrically.

3.5 Filterable Particulate Matter

EPA Reference Method 5, "Determination of Particulate Emissions From Stationary Sources,” was used to determine filterable particulate matter. The sampling train consisted of a glass nozzle, glass-lined probe, heated quartz-fiber filter, and a series of glass impingers followed by a vacuum pump, dry gas meter, and calibrated orifice. The sampling system was also used to collect metals samples. The probe and filter temperatures were maintained at 248°F ± 25°F. Thermocouples were used to monitor temperatures of the stack gas, sampling probe, filter, and impinger exit gas. Each run was approximately 180 minutes in order to collect the required 3-m^3 sample volume for the target metals. Figure 3-1 is a schematic of the sampling system. Each Method 5/29 test run was sampled concurrently with the $PM_{2.5}$/202 test run.

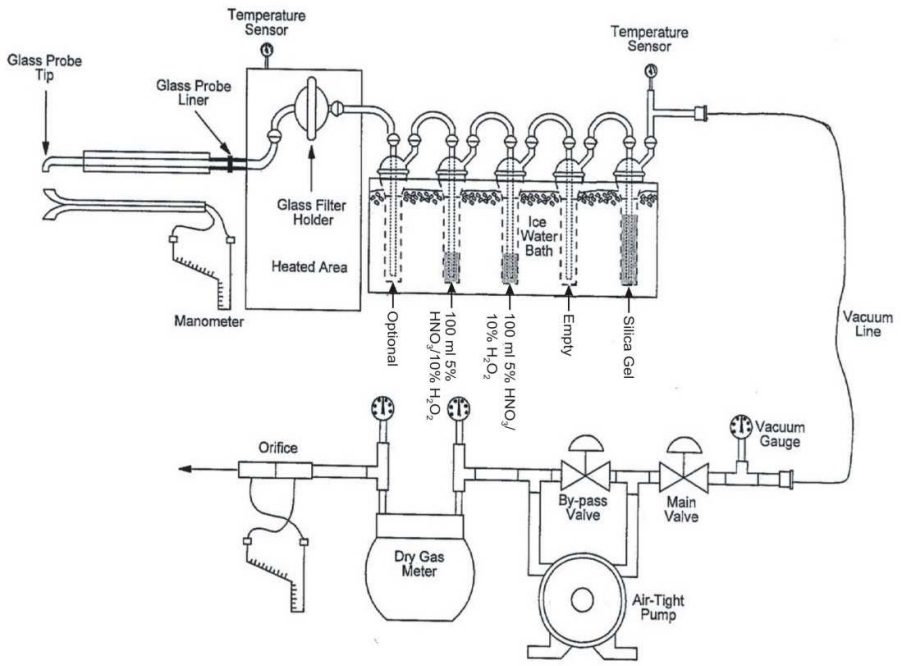

Figure 3-1. EPA Method 5/29 Sampling Train

3.6 Hydrogen Chloride and Hydrogen Fluoride

EPA Reference Methods 26A, "Determination of the Hydrogen Halide and Halogen Halide Emissions from Stationary Sources," was used to determine HCl and HF emissions. The sampling train consisted of a glass nozzle, glass-lined probe, heated teflon filter, and a series of four glass impingers followed by a vacuum pump, dry gas meter, and calibrated orifice. The sodium hydroxide impingers were omitted because only HCl and HF were measured. The probe and filter temperatures were maintained above 248°F. Thermocouples were used to monitor temperatures of the stack gas, sampling probe, filter, and impinger exit gas. Each run was approximately 60 minutes in order to collect the required 1-m^3 sample volume. Figure 3-2 is a schematic of the sampling system. Each Method 26A test run was sampled concurrently with the OTM 29 test runs.

Water samples were analyzed for HCl and HF by Standard Method 4500. Seven replicate samples were taken at three different days at EP-10.

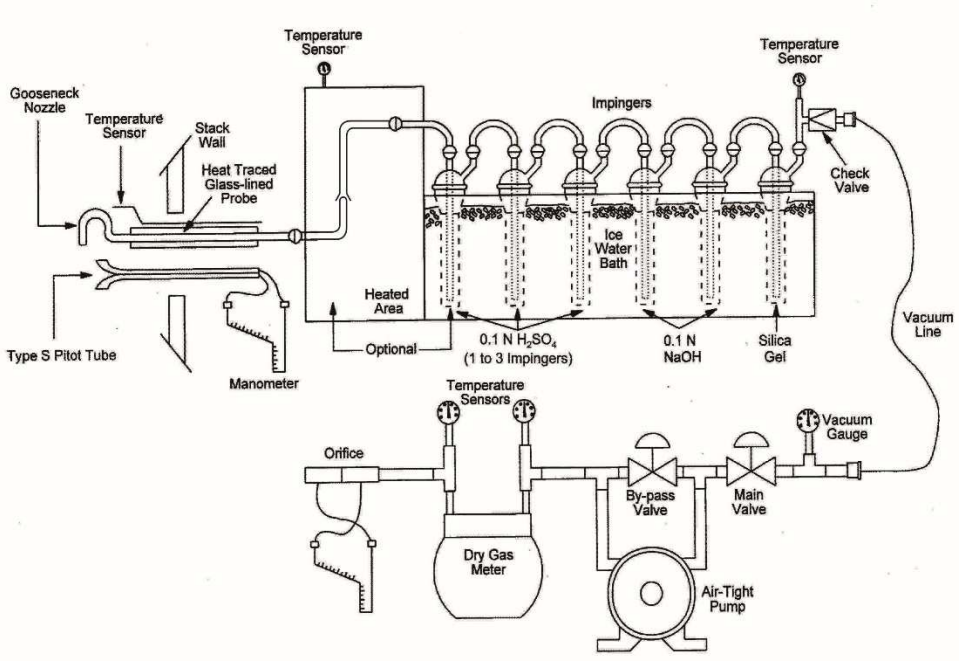

Figure 3-2. EPA Method 26A Sampling Train
(Note: The NaOH impingers were not used)

3.7 Metals

EPA Reference Method 29, "Determination of the Metals Emissions from Stationary Sources," was used to determine metals emissions. This sampling train was combined with the PM sampling. Each run was approximately 180 minutes in order to collect the required 3-m^3 sample volume. The target metals were: Sb, As, Be, Cd, Cr, Co, Pb, Mn, Hg, Ni, and Se. Figure 3-1 is a schematic of the sampling system.

Water samples were analyzed for the metals by EPA Method 200.7. Seven replicate samples were taken at three different days at EP-10.

3.8 Sulfur Dioxide and Carbon Monoxide

Sulfur dioxide concentrations were collected and analyzed for following the procedures of EPA Reference Method 6C, "Determination of Sulfur Dioxide Emissions from Stationary Sources by Instrumental Analyzer." Carbon monoxide concentrations were measured and analyzed for following the procedures of EPA Reference Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources by Instrumental Analyzer Technique." Three 60-minute sampling runs were conducted. The sampling system consists of a stainless-steel probe with a sintered or quartz wool filter for removing particulate matter, a heated Teflon sampling line, and a sample gas conditioner for removing moisture prior to gases entering the pulse fluorescence analyzer. A zero gas and two Protocol One calibration gases were used to calibrate each instrument. Data was collected with a data-logging system to record 1-minute averages of pollutant data. Figure 3-3 is a schematic of the continuous emission analyzer system.

Water samples were analyzed for total sulfate by SW846 Method 9056A.

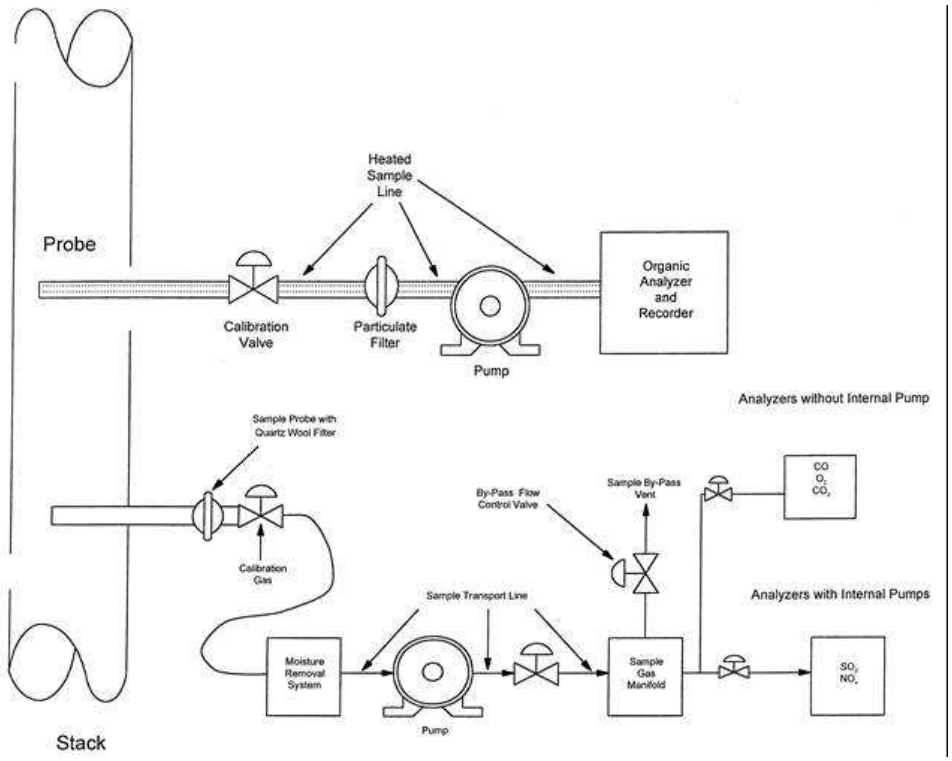

Figure 3-3. CEM Sampling System

3.9 Hydrogen Sulfide

A modified EPA Method 15, "Determination of Hydrogen Sulfide (H_2S), Carbonyl Sulfide (COS), and Carbon Disulfide (CS_2) from Stationary Sources," was used to determine hydrogen sulfide emissions. Bag samples were collected with an evacuated canister system with a probe, filter, and SO_2 scrubber setup. Bags were analyzed within 24 hours of sampling using a flame photometric detector. Each H_2S test run was conducted concurrently with the SO_2 test runs.

Water samples were analyzed for total sulfide by Standard Methods 4500-$S2^-$ Sulfide.

3.10 $PM_{2.5}$

The $PM_{2.5}$ emissions were determined by EPA Method 201A/202. The sampling train is shown in Figure 3-4 and consists of a stainless-steel nozzle, a 10-micron cut-off cyclone, an in-stack stainless steel filter holder manufactured by Andersen®, a glass probe, and an EPA Method 202 backhalf. Borosilicate glass fiber filters are used in the filter holder. Each sample is collected

isokinetically at a fixed sampling rate, and the number of minutes sampled at each traverse point is determined by the ratio of the point velocity to the average velocity. The velocity and temperature are measured at each traverse point as the sample is sampled.

The volume of the impinger solution and the weight of the silica gel are recorded before and after the tests in order to obtain the moisture content of the stack gas stream. All sample volumes and weights are recorded immediately on sample recovery sheets during charging and sample recovery. Leak checks are performed before and after each test.

The post-test leak check was performed after the cut-off cyclone was removed so as not to disturb the particle catch.

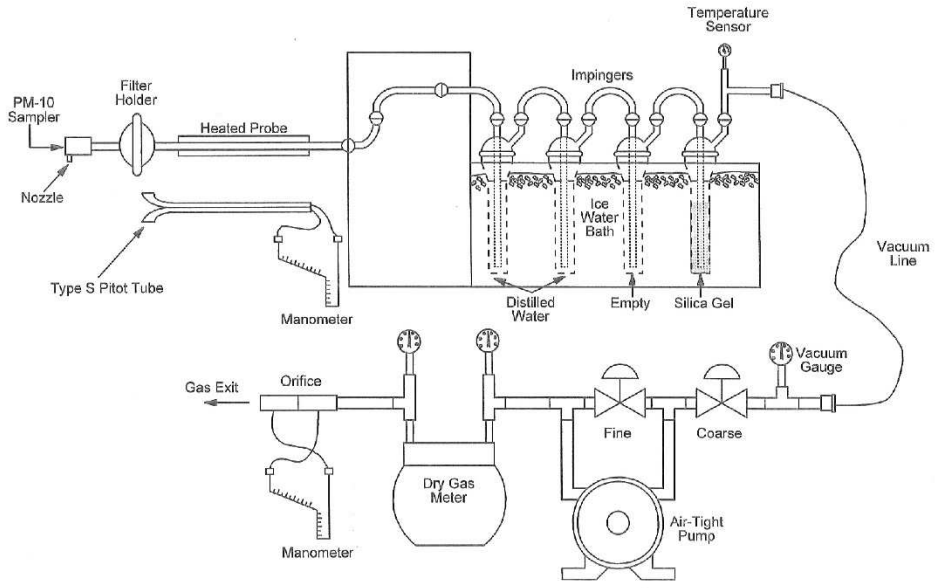

Figure 3-4. EPA Method 201A Sampling Train

3.11 Condensable Particulate Matter (Organic and Inorganic)

EPA Reference Method 202, "Determination of Condensable Particulate Emissions from Stationary Sources," was used to determine condensable organic and inorganic particulate matter. The Method 202 back-half sampling train was combined with the Method 5 and 201A sampling system to determine condensable particulate matter. The back-half of the train, which measures condensable particulate emissions, consists of a coil condenser, a large knockout impinger, an empty Greenburg-Smith impinger, a Teflon membrane filter (TMF), a Greenburg-Smith impinger charged with 100 ml of Type 1 water, and an impinger filled with silica gel.

After the dry impingers are recovered with the condensate catch with Type 1 water, they are rinsed with acetone and hexane into another separate amber glass container to determine condensable PM_{10}. The Teflon membrane filter is recovered into a glass petri dish. All sample volumes and weights are recorded immediately on sample recovery sheets during charging and sample recovery. The sampling train is shown in Figure 3-5.

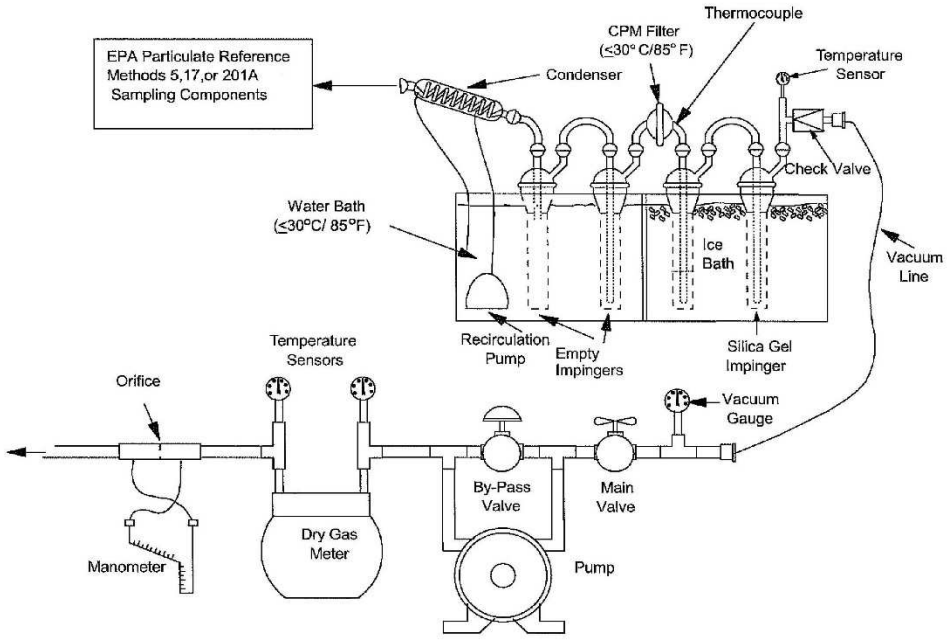

Figure 3-5. EPA Method 202 Sampling Train

3.12 Toluene-Soluble Organics (TSO)

EPA Reference Method 315, "Determination of Particulate and Methylene Chloride Extractable Matter (MCEM) from Selected Sources at Primary Aluminum Production Facilities," was used to determine TSO. The sampling system is similar to the EPA Method 5 system, with water in the first two impingers, an empty impinger, and an impinger with silica gel. The sample was recovered by an acetone rinse of the front half of the system. The impingers were rinsed with water, acetone, and then toluene. Each TSO test run was conducted concurrently with the semi-volatile HAP test runs.

3.13 Formaldehyde

EPA Reference Method 316, "Determination of Formaldehyde Emission from Stationary Sources," was used to determine formaldehyde concentrations. The sampling train consisted of a probe, Teflon sampling line, and a series of impingers (three containing high-purity water and the fourth containing silica gel), followed by a vacuum pump, dry gas meter, and calibrated orifice. The probe was maintained at 248° ± 25°F. Thermocouples were used to monitor temperatures of the stack gas, sampling probe, filter, and impinger exit gas. A schematic of the sampling train is shown in Figure 3-3. These samples were run for approximately 1 hour to collect the minimum volume requirement of 1 m^3. Each formaldehyde test run was conducted concurrently with the VOHAP test runs.

3.14 Hydrogen Cyanide

OTM 29, "Sampling for Hydrogen Cyanide Emissions," was used to measure HCN emissions. The system is similar to the Method 316 sampling system, but 6.0 N NaOH was used in the first three impingers. The pH of these impingers was measured at the conclusion of the run, and the pH of each impinger was verified to be above 12. These samples were run for approximately 1 hour to collect the minimum volume requirement of 1 m^3.

Water samples were analyzed for HCN by Standard Method 4500-CN.

3.15 Speciated VOHAP

Speciated Volatile Organic HAPs (VOHAP) emissions were measured by EPA Method SW846 0031. Each test run consisted of three sorbent traps. Figure 3-6 is a schematic of the sampling system.

Water samples were analyzed for VOHAP by EPA Methods 602 and 624, SW846 8260B.

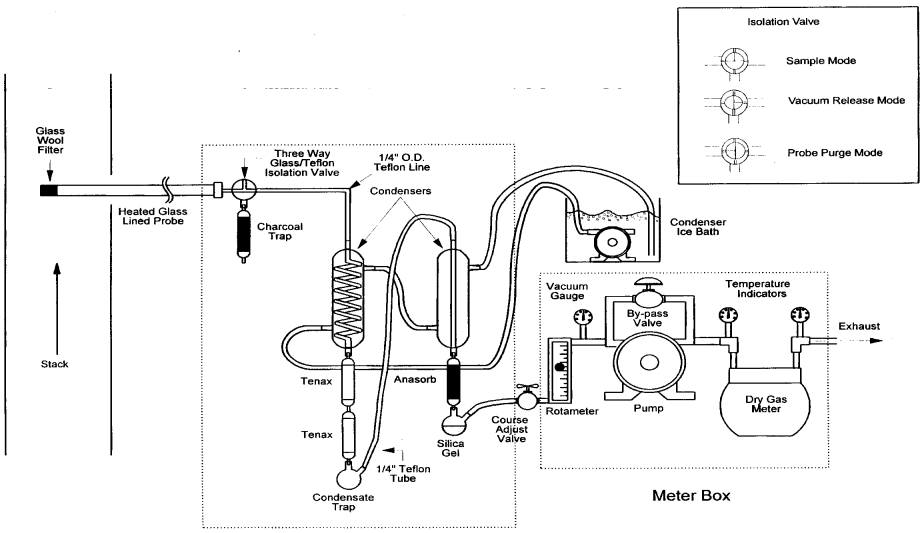

Figure 3-6. Method 0031 Sampling System

3.16 Visible Emission Observations

EPA Method 303 was used to monitor visible emissions from charging ports and doors, lids and offtakes. COMs were used to monitor opacity from the combustion stack. Visible emission data is included in Appendix F.

3.17 PCBs/Dioxins/Furans

California Air Resources Board (CARB) Method 428, "Determination of Polychlorinated Dibenzo-P-Dioxin (PCDD), Polychlorinated Dibenzofuran (PCDF), and Polychlorinated Biphenyle (PCB) Emissions from Stationary Sources," was used to measure the PCB, dioxin, and furan emissions. The particulate and gaseous phases were extracted isokinetically from the stack and collected on the XAD-2 resin and in the impingers or in upstream sampling train components (filter, probe, nozzle). The benzene rinse of the sampling components was completed due to the health exposure risk related to benzene. In place of benzene, toluene was used for these rinses. For possible clogging complications during the sample extraction in the lab, the methanol rinse was replaced with an acetone rinse. These are the same rinse reagents used in EPA Method 23, which also measures PCBs, dioxins, and furan emissions. Each run was approximately 240 minutes in order to collect the required 4 m^3 sample volume. These sample runs were conducted with the PAH sampling. Figure 3-7 is a schematic of the sampling system. Results were not blank corrected.

Water samples were analyzed for dioxin/furans by EPA Method 1613B.

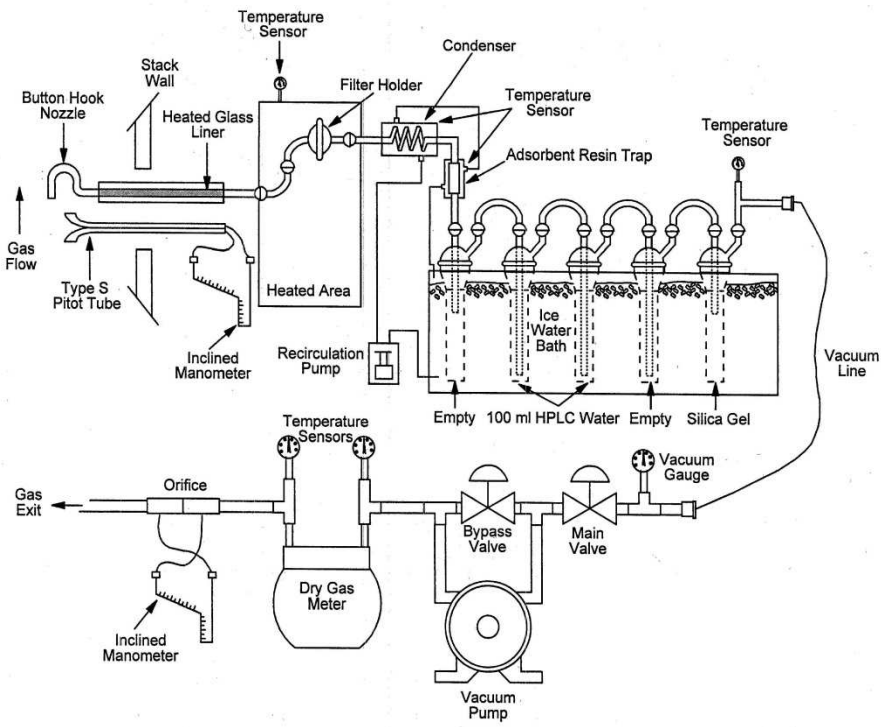

Figure 3-7. CARB 428 and 429 Sampling Train

3.18 PAHs

California Air Resources Board (CARB) Method 429, "Determination of Polycyclic Aromatic Hydrocarbon (PAH) Emissions from Stationary Sources," was used to measure the PAH emissions. The particulate and gaseous phase PAH was extracted isokinetically from the stack and collected on the XAD-2 resin and in the impingers or in upstream sampling train components (filter, probe, nozzle). Only the total amounts of each PAH in the stack emissions were determined with this method. The analytical method was isotope dilution mass spectrometry combined with high resolution gas chromatography (HRGC). This entails the addition of internal standards to all samples in known quantities, matrix-specific extraction of the sample with appropriate organic solvents, preliminary fractionation and cleanup of extracts, and analysis of the processed extract for PAH using high-resolution capillary column gas chromatography coupled with either low resolution mass spectrometry (HRGC/LRMS) or high resolution mass spectrometry (HRGC/HRMS). To ensure comparable results, the same MS method was used for samples collected at all of the tested locations. Each run was approximately

240 minutes in order to collect the required 4-m^3 sample volume. These test runs were conducted concurrently with the PCB/D/F sampling. Figure 3-7 is a schematic of the sampling system.

Water samples were analyzed for PAHs by EPA Method 610.

4. PROCESS OPERATION/SAMPLING LOCATIONS

AK Steel produces coke and coal derived by-products in the Wilputte Coke Battery at its Middletown Works facility. The Wilputte Coke battery is a series of 76 ovens fired by coke oven and blast furnace gasses. Each oven is divided into two chambers (the coke chamber and the combustion chamber). A brick wall separates the two chambers.

The 76 ovens are filled with coal. The coal is heated indirectly through the brick wall to approximately 2,100˚F for 17 to 20 hours during normal coking. The heat drives off the volatiles from the coal. The exhaust gasses are collected and converted into by-products (tar and anhydrous ammonia). The coke remains in the oven after the volatiles have been driven from the coal. The exhaust gasses from the combustion chamber are vented to a 14-foot inside-diameter vertical brick and concrete stack and to the pushing baghouse during the coke pushes.

Currently, the coke battery operates two shifts each day, 10 am to 6 pm and 10 pm to 6 am. Approximately 25 coke ovens are pushed during each shift, with an average coking time of 36 hours.

4.1 Sampling Location Description

Emissions from the Wilputte Coke Oven Battery combustion chamber exhaust through a 14-foot inside-diameter brick-and-concrete stack. Four sampling ports are located at 90-degree angles from each other in a plane perpendicular to the airflow. The sampling ports were located approximately 4.0 stack diameters downstream from the last flow disturbance (inlet) and approximately 13.0 stack diameters upstream of the next flow disturbance (top of stack). Sampling will be continuous at the combustion stack.

The Pushing Baghouse consists of five exhausts, of which three were operated and sampled during each run. Each exhaust is a circular, vertical section of 35.25-inch inside-diameter ductwork, with two ports at 288 inches [8.2 duct diameters (dd)] downstream of a bend and 66 inches (1.9 dd) upstream of a disturbance. Twelve points (6 per port) were used to traverse the duct during each test run. Sampling was only conducted during coke pushes

(baghouse fan on to baghouse fan off) and sampling was paused for the 4-hour breaks between shifts when it was necessary to collect samples over multiple days.

Table 4-1 presents a summary of sampling location measurements relative to the nearest flow disturbances.

Table 4-1. Sampling Location Parameters

Stack Identification	Stack I.D., inches	Distance to Nearest Disturbance		Number of Sampling Points Required, Total
		Upstream, inches	Downstream, inches	
EP-1: Pushing Baghouse	35.25	288	66	12
EP-3: Combustion Stack	168	672	2184	24

5. QUALITY ASSURANCE AND QUALITY CONTROL

The field sampling quality assurance for this project included the use of calibrated source sampling equipment, reference test methods, and traceability protocols for recording and calculating data. The analytical quality assurance included use of validated analytical procedures, calibration of analytical instruments, and analysis of control samples and blanks. The calibration and quality control procedures used for this test program are described in the following subsection.

5.1 Calibration Procedures and Frequency

All manual stack gas sampling equipment was calibrated before the test program in accordance with the procedures outlined in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 111, EPA-600/4-72-027B. Summarized in Table 5-1 are the stack gas sampling equipment calibrations that were performed in preparation for this project. The meter box was re-calibrated after the test.

Tables 5-2 and 5-3 list the additional calibration checks that were performed on the sampling equipment on site, just prior to the testing, to ensure that equipment was not damaged during transport. Analyzer checks are conducted directly to the instrument initially and then through the sampling system.

5.2 Field Blanks

A field blank of each sampling train was collected for each sampling location. After sample collection and recovery, the sampling train was assembled, leak checked, recovered, and submitted to the laboratory for analysis.

Table 5-1. Field Equipment Calibration Summary[a]

Equipment	Calibrated Against	Allowable Error
Method 5 meter box	Reference test meter	Y ± 0.02 Y ΔH @ ± 0.15 post-test Y ± 0.05
Orsat	Certified cylinder gas	± 0.5%
Pitot tube	Geometric specifications	See EPA Method 2
Thermocouple	ASTM-3F thermometer	±1.5%
Impinger (or condenser thermometer)	ASTM-3F	± 2° F
Dry gas thermometer	ASTM-3F	± 5° F
Probe nozzles	Caliper	± 0.004 in.
Barometer	NBS traceable barometer	± 0.1 in. Hg

[a]As recommended in the Quality Assurance Handbook for Pollution Measurement Systems: Volume III. Stationary Source-Specific Methods. EPA-600/4-77-027b, August 1997.

Table 5-2. Field Checks of Sampling Equipment

Equipment	Checked Against	Allowable Differences
Pitot tube	Inspection	No visible damage
Thermocouples	ASTM 2F or 3F	± 1.5%
Probe Nozzles	Caliper	± 0.004 in.

Table 5-3. Field Checks of O_2, CO_2, and CO Analyzers

Calibration Schedule	Instrument Check	Acceptable Limit
Initial Calibration	O_2, CO_2, & CO Calibration Error, % Span	±2%
	Sampling System Bias	< 5% of Span
Daily Calibration	O_2, CO_2, & CO Calibration Error, % Span	±2%
	O_2, CO_2, & CO Drift, % Span	< 3% of Span

APPENDIX A

CALCULATIONS

APPENDIX A-1

TOLUENE-SOLUBLE ORGANICS

APPENDIX A-2

FILTERABLE PM AND HAP METALS

APPENDIX A-3

$PM_{2.5}$ FILTERABLE AND CONDENSABLE

APPENDIX A-4

HYDROGEN SULFIDE, SULFUR DIOXIDE, AND CARBON MONOXIDE

APPENDIX A-5

SPECIATED VOLATILE ORGANIC HAP (VOHAP)

APPENDIX A-6

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE

APPENDIX A-7

HYDROGEN CYANIDE

APPENDIX A-8

SEMI-VOLATILE ORGANIC HAP

APPENDIX A-9

FLOW

APPENDIX B

FIELD DATA

APPENDIX B-1

TOLUENE-SOLUBLE ORGANICS

APPENDIX B-2

FILTERABLE PM AND HAP METALS

APPENDIX B-3

$PM_{2.5}$ FILTERABLE AND CONDENSABLE

APPENDIX B-4

HYDROGEN SULFIDE

APPENDIX B-5

SULFUR DIOXIDE AND CARBON MONOXIDE

APPENDIX B-6

SPECIATED VOLATILE ORGANIC HAP (VOHAP)

APPENDIX B-7

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE

APPENDIX B-8

HYDROGEN CYANIDE

APPENDIX B-9

SEMI-VOLATILE ORGANIC HAP

APPENDIX B-10

FLOW

APPENDIX C

ANALYTICAL DATA

APPENDIX C-1

TOLUENE-SOLUBLE ORGANICS

APPENDIX C-2

FILTERABLE PM AND HAP METALS

APPENDIX C-3

$PM_{2.5}$ FILTERABLE AND CONDENSABLE

APPENDIX C-4

HYDROGEN SULFIDE

APPENDIX C-5

COKE OVEN GAS ANALYSIS

APPENDIX C-6

SPECIATED VOLATILE ORGANIC HAP (VOHAP)

APPENDIX C-7

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE

APPENDIX C-8

HYDROGEN CYANIDE

APPENDIX C-9

SEMI-VOLATILE ORGANIC HAP

APPENDIX C-10

QUENCH WATER ANALYSIS

APPENDIX D

QUALITY ASSURANCE/QUALITY CONTROL

APPENDIX E

VISIBLE EMISSIONS

APPENDIX F

USEPA ICR